

TONTO DRILLING SERVICES, INC.
NW SW 23-6N-30E #1 Alpine-Fed. (878)

COUNTY APACHE AREA ALPINE LEASE NO. N/A

WELL NAME #1 ALPINE-FEDERAL

LOCATION NE SW SEC 23 TWP 6N RANGE 30E FOOTAGE 1152.96 FWL, 2122.34' FSL

ELEV 8556' GR KB SPUD DATE 7/7/93 STATUS COMP. DATE 9/1/93 TOTAL DEPTH 4505'

CONTRACTOR TONTO DRILLING SERVICES P&A 9/29/96 by TONTO DRLG

CASING SIZE	DEPTH	CEMENT	LINER SIZE & DEPTH	DRILLED BY ROTARY
6 5/8"	26'	4 sxs	3.5" 2510' - 3369'	X
4 1/2"	500'	40 sxs		DRILLED BY CABLE TOOL
NQ - 3 1/4"	4505'	none (observation)		PRODUCTIVE RESERVOIR <u>N/A</u>
				INITIAL PRODUCTION <u>N/A</u>

FORMATION TOPS	DEPTHS	SOURCE		REMARKS
		L.L.	E.L.	
TERT. DATIL ?	SURF			TOPS PICKED BY OPERATOR, HOLE CORED FROM
EOCENE BACA FM	1093'			500' to 4505'. TERTIARY CORE FROM SURF TO
TERT. REDBEDS	3139'			3255' ON PERMANENT LOAN TO NEW MEXICO BUREAU
CRET. DAKOTA SS?	3260'			MINES & MINERAL RESOURCES, SOCCORO NM.
PERMIAN SAN ANDRES	3369'			
PERM GLORIETA SS	3436'			
PERM YESO FM	3751'			
MAFIC DIKES	3636, 4250', & 4454'			

ELECTRIC LOGS	PERFORATED INTERVALS	PROD. INTERVALS	SAMPLE LOG
GAMMA RAY-NEUTRON	NONE	NONE	SAMPLE DESCRP.
TEMPERATURE			SAMPLE NO. <u>1875</u>
			CORE ANALYSIS <u>GEOCHEMICAL</u>
			DSTs <u>NONE</u>

REMARKS THIS HOLE TURNED OVER TO US GEOL. SURVEY AS A SCIENTIFIC
OBSERVATION HOLE ON MAY 6, 1994 (SEE FORM 26 THIS FILE)
**WELL P&A 9/29/96 BY USGS

APP. TO PLUG 8/26/96
PLUGGING REP. 10/3/96
COMP. REPORT 9/30/93

WATER WELL ACCEPTED BY _____

BOND CO. INSURANCE CO. OF STATE OF PENNSYLVANIA BOND NO. 115574
DATE 04/27/93

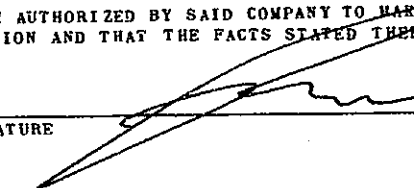
BOND AMT. \$ 5,000.00 CANCELLED 7-18-94 ORGANIZATION REPORT YES, 04/23/93

FILING RECEIPT 3040 LOC. PLAT ✓ WELL BOOK ✓ PLAT BOOK ✓

API NO. 02-001-90012 DATE ISSUED 05/18/93 DEDICATION N/A - Start test

PERMIT NUMBER 878

(over)

WELL COMPLETION OR RECOMPLETION REPORT AND WELL LOG											
GEOTHERMAL RESOURCE WELL											
DESIGNATE TYPE OF COMPLETION:											
NEW WELL <input type="checkbox"/>	WORK OVER <input type="checkbox"/>	DEEPEN <input type="checkbox"/>	PLUG BACK <input type="checkbox"/>	SAME RESERVOIR <input type="checkbox"/>	DIFFERENT RESERVOIR <input type="checkbox"/>	DRY STEAM <input type="checkbox"/>	HOT WATER <input type="checkbox"/>	DRY <input checked="" type="checkbox"/>			
DESCRIPTION OF WELL AND LEASE											
OPERATOR Tonto Drilling Services, Inc.						ADDRESS 2200 South 4000 West					
FEDERAL, STATE OR INDIAN LEASE NUMBER OR NAME OF LESSOR IF FEE LEASE Tonto/Alpine #1/Federal						WELL NUMBER FIELD & RESERVOIR API # 02-001-90012 wildcat					
LOCATION Alpine Divide/5 miles north of Alpine						COUNTY Apache					
SEC. TWP-RANGE OR BLOCK & SURVEY sec 23, T6N, R30E 1152.96 FWL 2122.34 FSL											
DATE SPUDDED 7/7/93		DATE TOTAL DEPTH REACHED 8/29/93		DATE COMPLETED, READY TO PRODUCE 9/1/93		ELEVATION (OF. RT. OR GR.) 8555.59 FEET		ELEVATION OF CASING HD. FLANGE n/a FEET			
TOTAL DEPTH 4505		P.B.T.D. n/a		AIRDRIILLED (INTERVAL) none		FLUIDDRIILLED (INTERVAL) 0 - 4505					
PRODUCING INTERVAL (S) FOR THIS COMPLETION none						ROTARY TOOLS USED (INTERVAL) 0 - 4505		CABLE TOOLS USED (INTERVAL) none			
WAS THIS WELL DIRECTIONALLY DRILLED? no		WAS DIRECTIONAL SURVEY MADE? no		WAS COPY OF DIRECTIONAL SURVEY FILED? no		DATE FILED n/a					
TYPE OF ELECTRICAL, TEMPERATURE, CEMENT BOND OR OTHER LOGS RUN (CHECK LOGS FILED WITH THE COMMISSION) temperature gamma neutron						DATE FILED to be filed (11/93)					
CASING RECORD											
CASING (REPORT ALL STRINGS SET IN WELL-CONDUCTOR, SURFACE, INTERMEDIATE, PRODUCING, ETC.)											
PURPOSE	SIZE HOLE DRILLED	SIZE CASING SET	WEIGHT (LB./FT.)	DEPTH SET	SACKS CEMENT	AMT. PULLED					
conductor	7 7/8	6 5/8	24	20	4	none					
surface	5 7/8	4 1/2	116	500	40	none					
observation	3.782 to 2.98	NO 2 3/4	52	4505	none	none					
TUBING RECORD											
SIZE	DEPTH SET	PACKER SET AT	SIZE	TOP	BOTTOM	SACKS CEMENT	SCREEN (FT.)				
IN.	FT.	FT.	HO 3.5 IN.	2510 FT.	3369 FT.	22	none				
PERFORATION RECORD											
NUMBER PER FT.	SIZE & TYPE	DEPTH INTERVAL		AMT. & KIND OF MATERIAL USED		DEPTH INTERVAL					
INITIAL PRODUCTION											
DATE	STATIC TEST SHUT IN WELL HEAD		ANALYSES OF FLUIDS & GASES								
			TOTAL MASS FLOW DATA				SEPARATOR DATA				
	TEMP. °F	PRES. PSIG.	LBS./HR.	TEMP. °F	PRES. PSIG.	ENTHALPY	ORIFICE	WATER CUFT/HR.	STEAM LBS/HR.	PRES. PSIG.	TEMP. °F
CERTIFICATE: I, THE UNDERSIGNED, UNDER THE PENALTY OF PERJURY, STATE THAT I AM THE <u>Vice Pres./Gen. Mgr.</u> OF THE <u>Tonto Drilling Services</u> (COMPANY). AND THAT I AM AUTHORIZED BY SAID COMPANY TO MAKE THIS REPORT: AND THAT THIS REPORT WAS PREPARED UNDER MY SUPERVISION AND DIRECTION AND THAT THE FACTS STATED THEREIN ARE TRUE, CORRECT AND COMPLETE TO THE BEST OF MY KNOWLEDGE.											
DATE September 30, 1993		SIGNATURE 									
DATE OCT 1 1993		AZ OIL & GAS CONSERVATION COMMISSION									
PERMIT NO. 878						STATE OF ARIZONA OIL & GAS CONSERVATION COMMISSION WELL COMPLETION OR RECOMPLETION REPORT AND WELL LOG FILE ONE COPY FORM NO. G-4					

(COMPLETE REVERSE SIDE)

DETAIL OF FORMATIONS PENETRATED

FORMATION	TOP	BOTTOM	DESCRIPTION*
Miocene (?)/ Oligocene (?) Datil (?) Pueblo Creek (?)	0	1093 (?)	Detailed lithologic description to be filed (11/93)
Eocene/Paleocene Baca Fm	1093 (?)	3139	
Paleocene (?)/ Upper Cretaceous (?) 'LaOrange fm'	3139	3260	
Cretaceous Dakota (?) Fm	3260	3369	
Permian San Andres Fm	3369	3436	
Permian Glorieta Fm	3436	3636 - 3751	
Permian Yeso Fm	3636 - 3751	4454+	
basalt intrusions (sills and/or dikes) upper Tertiary	3636 4260 4327 4454	3751 4322 4362 4505	

* SHOW ALL IMPORTANT ZONES OF POROSITY. DETAIL OF ALL CORES, AND ALL DRILL-STEM TESTS, INCLUDING DEPTH INTERVAL TESTED, CUSHION USED, TIME TOOL OPEN, FLOWING AND SHUT-IN PRESSURES, AND RECOVERIES.

INSTRUCTIONS:

ATTACH DRILLERS LOG OR OTHER ACCEPTABLE LOG OF WELL.

THIS WELL COMPLETION OR RECOMPLETION REPORT AND WELL LOG SHALL BE FILED WITH THE STATE OF ARIZONA OIL & GAS CONSERVATION COMMISSION NOT LATER THAN THIRTY DAYS AFTER PROJECT COMPLETION.

FORM NO. G-4

Form 3260-3
(formerly 9-1958)
(June 1988)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
GEOTHERMAL SUNDRY NOTICE

FORM APPROVED
OMB NO. 1004-0132
Expires: September 30, 1990

The Bureau of Land Management (BLM) requests this form or other BLM-approved forms to be prepared and filed in triplicate with requisite attachments with the authorized officer. The authorized officer must approve this permit prior to any lease operations.

1a. Well Type: ☐ Production ☐ Injection ☐ Heat Exchange ☒ Observation ☐ Other

1b. Well Status:

P AND A PLAN OF OBSERVATION WELL.

2. Name of Lessee/Operator

U.S. GEOLOGICAL SURVEY

3. Address of Lessee/Operator

2255 N. GEMINI DR. FLAGSTAFF, AZ. 86001

4. Location of Well or Facility

T6N, S30E, SEC 23 1153 WL, 2122SL.

5. Type of Work

- | | | |
|---|---|---|
| <input type="checkbox"/> Change Plans | <input type="checkbox"/> Convert to Injection | <input type="checkbox"/> Pull or Alter Casing |
| <input type="checkbox"/> Site and Road Construction | <input type="checkbox"/> Fracture Test | <input type="checkbox"/> Multiple Complete |
| <input type="checkbox"/> Construct New Production Facilities | <input type="checkbox"/> Shoot or Acidize | <input checked="" type="checkbox"/> Abandon |
| <input type="checkbox"/> Alter Existing Production Facilities | <input type="checkbox"/> Repair Well | <input type="checkbox"/> Other |

6. Lease Serial No.

N/A

7. Surface Manager: ☐ BLM ☒ FFS
☐ Other

8. Unit Agreement Name

N/A

9. Well No.

ALPINE #1

10. Permit No.

USGS/USFS

MOU.

11. Field or Area

ALPINE

12. Sec., T., R., B. & M.

S23, T6N, R30E

13. County

APACHE

14. State

ARIZONA

15. Describe Proposed Operations (Use this space for well activities only. See instructions for current well conditions on reverse)

RIG UP, REMOVE WELLHEAD. PUSH NQ PLUG TO F.L. PULL UP 50-100' AND CUT OFF NQ ROD. TOOH. TRIP IN WITH BQ ROD AND PUMP ~7 SACK MIX OF CEMENT (~5 1/2-6 gals H₂O PER SACK) ON TOP OF NQ PLUG. TOOH. PUSH 4 1/2" PLUG TO TOP OF CEMENT. PULL UP 200'. PUMP 15 SACK MIX ON TOP OF PLUG TO FILL TO ~450' (50' ABOVE CASING SHOE. TOOH. RINSE PUMP & TUBING. PUSH 4 1/2" PLUG INTO 4 1/2" CASING TO 50'. MIX AND PUMP 5 SACK MIX OF CEMENT TO SURFACE. REMAINDER TO COVER AREA AROUND TOP OF HOLE FOR SETTING HOLE DESCRIPTION PLAQUE. RIG DOWN. MOVE OFF OF HOLE. RAKE AREA AND SEED SURFACE. ACTUAL - SET 8 SACK MIX ABOVE BOTTOM PLUG - SET 2ND PLUG @ 580' - 15 SACK MIX ABOVE 2ND PLUG, SET TOP PLUG @ 50' PUMPED 6 SACK MIX TO SURFACE AND FILLED

16. Describe Proposed Operations (Use this space for all activities other than well work)

AROUND SURFACE TO MAKE CEMENT PAD OVER WELL.

17. I hereby certify that the foregoing is true and correct

Signed

Frank K. Sull

Title

LESSEE REPRESENTATIVE (USGS)

Date

30 SEP 96

(This space for Federal use)

Approved by

Conditions of Approval, if any:

Title

PETROLEUM ENGINEER

Date

10/2/96

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

(Instructions on reverse)

file 878

Form 3260-4
(formerly 9-1960)
(June 1988)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

GEOTHERMAL WELL COMPLETION REPORT

FORM APPROVED
OMB NO. 1004-0132
Expires: September 30, 1990

The Bureau of Land Management (BLM) requires this form or other BLM-approved forms to be prepared and filed in duplicate with requisite attachments with the authorized officer within 30 days after completion of permitted operations.

1a. Well Type: ☐ Production ☐ Injection ☐ Disposal ☐ Water Supply ☒ Observation
☐ Cold ☐ Heat Exchange ☐ Other

1b. Completion: ☐ New ☐ Workover ☐ Deepened ☐ Plugback ☐ Redrill
☐ Recompleted ☒ Drilled & Abandoned ☐ Other

2. Name of Lessee/Operator

U.S. GEOLOGICAL SURVEY

3. Address of Lessee/Operator

2255 N. GEMINI DR. FLAGSTAFF, AZ. 86001

18. Location of Well

At Surface: T6N, R30E, SEC. 23, 1153 WL., 2122 SL.

At Top of Production Zone:

At Total Depth:

19. Total Depth

Measured 4505'

True Vertical:

20. Plugback Total Depth

Measured:

True Vertical:

21. Elevation: ☒ Estimated ☐ Final

8570'

Reference Datum: ☐ GR ☐ MAT ☐ DF ☐ KB ☐ RT ☒ Casinghead Flange ☐ Other

22. Drilling Media: ☐ Air ☒ Water ☐ Mud ☐ Foam ☒ Other

List Characteristics:

CORING: WATER + CORING FLUID

23. Log Type & Intervals

TEMPERATURE 0'-4505'; GAMMA 0'-4505'; NEUTRON 0'-4505' ALL ATTACHED

24. CASING RECORD

Size	Weight	Grade	Collars & Threads	Depths Set Top	Shoe	Hole Size	Cementing Record (slurry volume)
6"				GL	20'	8 3/8" to 20'	
4 1/2"				GL	500'	6" to 500'	
NQ ROD				GL	4505'	4 1/2" to 3369' 5/8" to 4505'	

25. LINER RECORD

Size	Weight	Grade	Collars & Threads	Top	Bottom	Perforated Intervals	Cementing Record (slurry volume)
N/A							

26. TUBING RECORD

Size	Weight	Grade	Depth Set	Packer Depth
N/A				

27. Cement Squeeze, Acid, Fracture, etc. (detail type, amount, intervals)

28. PERFORATION RECORD

Type	Total No.	Density (No./ft)	Size	Intervals
N/A				

29. Attachments & Previous Submittals: List all reports, surveys, tests and logs, not listed in item 23, which have resulted from drilling and completion operations. List relevant previously furnished data with date of submittal referenced.

30. Well Status: ☐ Producing ☐ Shut-In ☐ Suspended ☐ Injection ☐ Disposal ☐ Heat Exchange ☒ Abandoned ☐ Water Supply ☐ Other

31. Do you consider the well to be commercial? ☐ Yes ☒ No Explain: OBSERVATION & STRATIGRAPHIC TEST WELL.

32. I hereby certify the information on this report and the attached information is complete and accurate according to the best of my knowledge.

Signed:

Frank V. Smith

Title

LESSEE REPRESENTATIVE (USGS)

Date

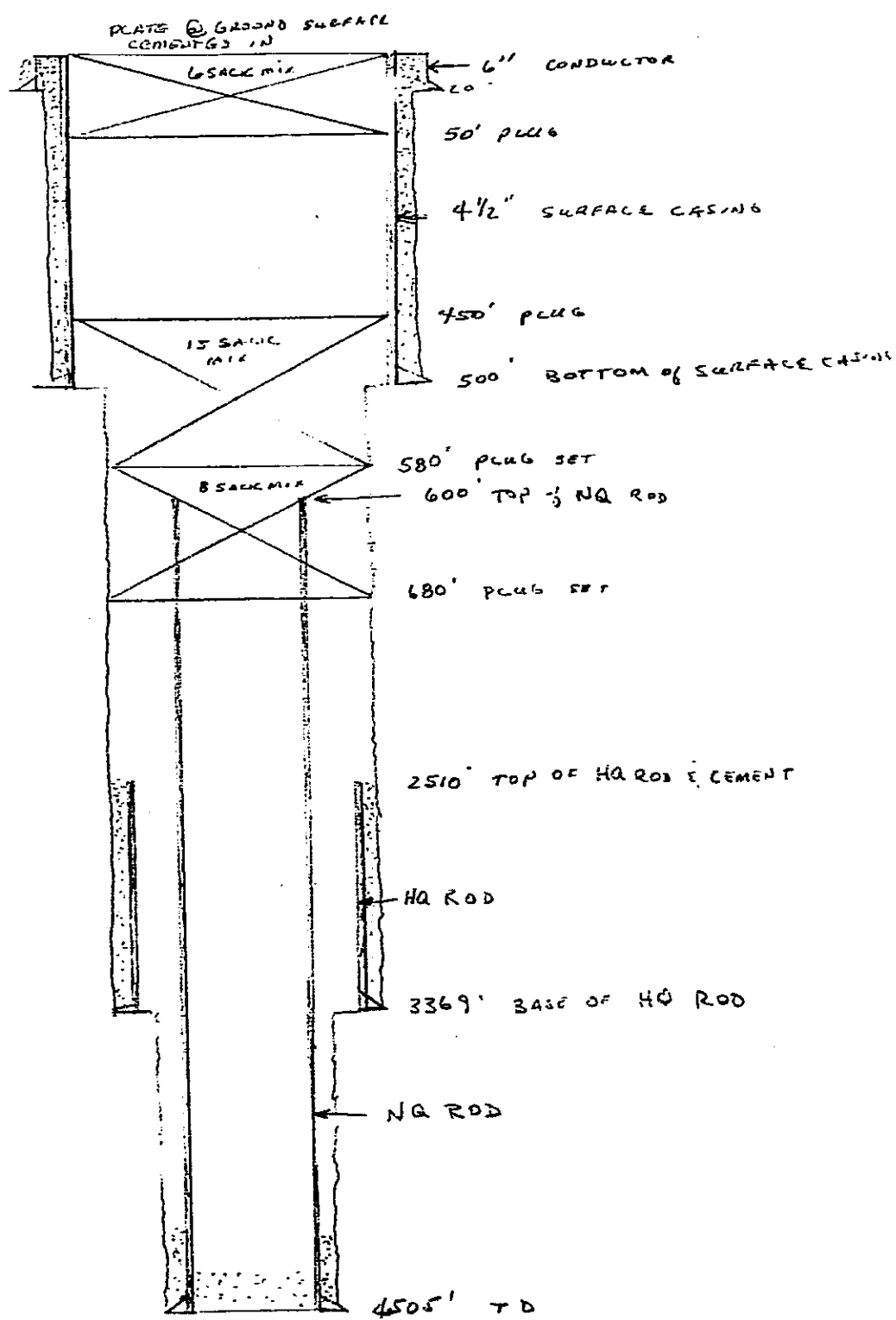
30 SEPT. 96

(Continued on reverse)

file 878

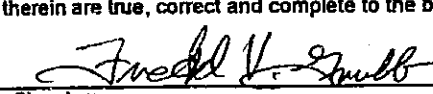
33. WELL TEST						
Test Date <i>N/A</i>	Production Method: <input type="checkbox"/> Flowing <input type="checkbox"/> Pumping - include size, type, intake depth, etc. <input type="checkbox"/> Other					
34. PRODUCTION						
Hours Tested <i>N/A</i>	Production During Test			Enthalpy (Btu/lb)		
	Total Liquids (lb)	Steam (lb)	Water (lb)			
35. STATIC TEST DATE						
Depth <i>N/A</i>	Surface Pressure (psig)	Subsurface Pressure (psig)	Subsurface Temperature (°F)	Water Analysis		
				Total Dissolved Solids	pH	
36. FLOWING TEST DATA						
Surface Pressure Wellhead: <i>0 psi</i> Separator:	Subsurface Pressure at _____ feet	Surface Temperature	Subsurface Temperature at top of perfs.	Avg. Total Mass Flow Rate Per Hour		
				Total (lb/hr)	Steam (lb/hr)	Water (lb/hr)
37. SUMMARY OF POROUS ZONES. Show all important porous zones and contents of each; cored intervals with recoveries, drill stem or formation tests with depth of interval tested, time open, cushion used, and flowing and shut-in pressures, temperatures and recoveries.				38. GEOLOGIC MARKERS (TOP)		
Formation	Top	Bottom	Description of Details	Name	Measured Depth	True Vertical Depth
Pueblo Creek	GL.	1093'	Tertiary volcanic and volcanoclastic unit. Rotary drilled to 500' Low Porosity cored to bottom. Andesite Porph. breccia 854'-942'. Ash flow 1018'-1038'	Pueblo Creek	0'-1093'	Survey not run.
Mogollon Rim	1093'	3139'	Conglomerate 1093'-1266' Porous Siltstone-Med 1266'-2850' Med Porosity w/ some cong.	Mogollon Rim	1093'-3139'	
La Orange	3139'	3260'	Conglomerate 2850'-3139' Porous Siltstone to fine-med 3139'-3260' Late K. red to orange	La Orange	3139'-3260'	
Dakotas ss	3260'	3369'	Med-coarse Carbonaceous ss early T. Low Porosity	Dakota ss	3260'-3369'	
San Andreas	3369'	3436'	fine xtaline Ls Permian Low Porosity	San Andreas	3369'-3436'	
Glorieta ss	3436'	3636'	Med to fine grain ss Permian Low Porosity	Glorieta ss	3436'-3636'	
Basalt dike	3636'	3751'	Late Tertiary intrusive in contact zone. Low Porosity	Late Tert. Basalt dike	3636'-3751'	
Corduroy	3751'	4260'	Anhydrite & Dolomite Low Porosity Permian	Corduroy	3751'-4260'	
Basalt dike	4260'	4362'	Late Tertiary Basalt dike Low Porosity	Basalt dike w/ Ft. Apache Ls	4260'-4362' (4322'-4327')	
Ft. Apache Ls	4322' 4362'	4327' 4405'	Limestone fine grained. Low Porosity Permian	Ft. Apache Ls	4362'-4405'	
Big A Butte	4405'	4454'	Fine sand to siltstone Low Porosity Permian	Big A Butte	4405'-4454'	
Basalt dike	4454'	4505'	Late Tertiary Basalt Low Porosity	Basalt Dike	4454'-4505'	

ALPINE #1 GEOTHERMAL WELL
 Schematic of Plugged Well



PLUGGED 9/28-29/96
 BY TONTO DRILLING

WITNESSED By: Fred Grubb, U.S.G.S
 & JOHN HAAS, BLM (PAINT TIME)

PLUGGING RECORD					
Operator Tonto Drilling			Address & Phone number P.O. Box 25128 (801) 974-0645 Salt Lake City, Utah 84120		
Federal, State, or Indian Lease No. or lessor's name if fee lease N/A		Well No. Alpine #1		Field & Reservoir Stratigraphic Test	
Location of Well 33 53.9' N. 109 09.3' W. T6N. R30E. NE. SW Sec 23			Sec - Twp - Rge NE. SW Sec 23		County Apache
Application to drill this well was filed in name of Tonto Drilling/ USBOE		Has this well ever produced oil or gas NO		Character of well at completion (initial production): Oil (bbls/day) N/A Gas (MCF/day) N/A Dry? YES	
Date plugged 29 September 1996		Total depth 4505'		Amount well producing when plugged: Oil (bbls/day) 0 Gas (MCF/day) 0 Water (bbls/day) 0	
Name of each formation containing water . Indicate which formation open to wellbore at time of plugging		Fluid content of each formation		Depth interval of each formation	
Pueblo Creek		water level- 675'		0'-1093'	
				2 7/8" @ 680' 7sacks cement on top	
				4 1/2" @ 600' 15sacks cement on top	
				4 1/2" @ 40' 6 sacks cement to surface	
CASING RECORD					
Size pipe	Put in well (ft.)	Pulled out (ft.)	Left in well (ft.)	Give depth and method of parting casing (shot, etc.)	Packers and shoes
6"	20'	0'	20'		
4 1/2"	500'	0'	500'		shoe @ 500'
2.98"NQ	4505'	600'	3905'	600' cut off	
Was well filled with heavy drilling mud, according to regulations? NO				Indicate deepest formation containing fresh water ? Late Tertiary Basalt @ well TD	
NAME AND ADDRESSES OF ADJACENT LEASE OPERATORS OR OWNERS OF THE SURFACE					
Name		Address		Direction from this well	
N/A					
In addition to other information required on this form, if this well was plugged back for use as a fresh water well, give all pertinent details of plugging operations to base of fresh water sand, perforated interval to fresh water sand, name and address of surface owner, and attach letter from surface owner authorizing completion of this well as a water well and agreeing to assume full liability for any subsequent plugging which might be required.					
Use reverse side for additional detail.					
CERTIFICATE: I, the undersigned, under the penalty of perjury, state that I am the <u>Client rep. (U.S.G.S.)</u> of the <u>Tonto Drilling</u> (company) and that I am authorized by said company to make this report; and that this report was prepared under my supervision and direction and that the facts stated therein are true, correct and complete to the best of my knowledge.					
Date 3 October 1996		Signature 			
Mail completed form to: Oil and Gas Program Administrator Arizona Geological Survey 416 W. Congress, #100 Tucson, AZ 85701			STATE OF ARIZONA OIL & GAS CONSERVATION COMMISSION Plugging Record File One Copy		
Permit No. 878			Form No. 10		

APPLICATION TO PLUG AND ABANDON

FIELD Stratigraphic Test P.O.Box 25128, 2200 South
4000 West, Salt Lake City
Utah 84120 (801)974-0645

OPERATOR Tonto Drilling ADDRESS & PHONE _____

LEASE NUMBER (Lessor's name if fee) N/A WELL NO. Alpine Federal #1

LOCATION NE, SW Sec 23, T06N, R30E

33 53.9' North Latitude 109 09.3' West Longitude

TYPE OF WELL Geothermal Test TOTAL DEPTH 4505 Feet
(Oil, Gas, or Dry)

ALLOWABLE (If Assigned) N/A

LAST PRODUCTION TEST OIL N/A (Bbls.) WATER N/A (Bbls.)
GAS N/A (MCF) DATE OF TEST N/A

PRODUCING HORIZON N/A PRODUCING FROM N/A TO N/A

1. COMPLETE CASING RECORD

6" Conductor pipe: Surface to 500'
2 3/4" NQ Coring Rod: Surface to 4505', Total Depth

2. FULL DETAILS OF PROPOSED PLAN OF WORK

See attached two-paged sheet, titled P & A Operation, Alpine AZ.

DATE COMMENCING OPERATIONS 23 September 1996

NAME OF PERSON DOING WORK Fredd Grubb ADDRESS 2255 N. Gemini Dr.
Flagstaff, AZ. 86001

Signature Fredd Grubb
Title Physical Science Technician
Address 2255 N. Gemini Dr. Flagstaff, AZ. 86001
(520) 556-7183
Date 22 August 1996

Mail two copies of completed form to:
Oil and Gas Program Administrator
Arizona Geological Survey
416 W. Congress, #100
Tucson, AZ 85701

Date Approved 8-26-96
STATE OF ARIZONA
OIL & GAS CONSERVATION COMMISSION
By Steven L. Raiz

STATE OF ARIZONA
OIL & GAS CONSERVATION COMMISSION
Application to Plug and Abandon
File Two Copies
Form No. 9

Permit No. 878

P & A OPERATION
ALPINE, ARIZONA

Client Contact: Fred Grubb, USGS
(520)556-7183

OPERATION

1. Mobilize truck 38, Ernie's truck and trailer to Alpine, Arizona
2. Go to site, remove fence, get backhoe to lift off well head protector, open valves, bleed off any pressure, set up rig over hole
3. Have backhoe dig small sump
Remove valving off of well head
4. Run in hole with BQ rod and cutter
Cut NQ liner pipe at water table or 750', whichever is shallower
5. Once cut is made, pull the BQ rod out.
6. Unbolt wellhead. Hook into NQ rod (may need Bowen Spear) and lifter. Hold NQ rod with manual foot clamp below the well head
7. Remove well head. Hoist NQ rod up through head, hook up pump, break circulation. Pump 100 feet of cement (100 gallons)
8. Pump 20 gallons wash water, pull NQ rods up to 50'

EQUIPMENT NEEDED

- Trash pump
- Diaphragm pump
- Cow trough (2 each)
- 250 gallon tank (1 each)
(Mounted on Ernie's truck)
- Fuel tank, pump, hose
- Timbers for blocking rig
- Backhoe
- May need
- Oxygen/acetylene torch
if threads are siezed
- 750 BQ drill rod
- Good BW casing cutter
- BQ handling tools
- Water hauled by Ernie
- NQ Bowen Spear
- NQ sized manual foot
clamp base plate
- NQ handling tools
- Trash pump to mix
cement in cow trough
- 15 sacks Portland cement

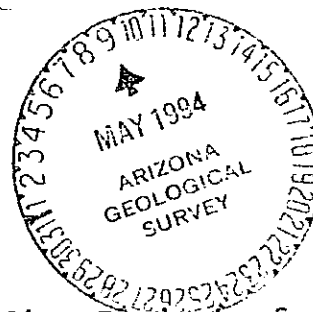
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|-----|---|---|--|
| 9. | Mix and pump another 100 gallons cement. | - | 15 sacks Portland cement |
| 10. | Clean up all cementing equipment, pump waste water into ditch alongside highway (as per Forest Service). Rig down, move rig off site. | - | 100 feet waterline |
| 11. | Remobilize back hoe. Dig down 3' around well head
Cut off casing 3' down, weld a plate over the top of casing (HW casing) | - | 4-1/2" diameter round sleeve (Steel) plate 1/2" thick |
| | | - | Arc welder |
| | | - | Oxygen acetylene cutting torch |
| 12. | Cement the well marker sign in place | - | 10 sacks Portland cement |
| | | - | 1/2 yard gravel |
| | | - | Cement mixer |
| | | - | Well marker prebuilt by shop (Specs of this marker attached) |
| 13. | Fill in sump. Re-claim site. Restore fencing. | - | Back hoe |
| 14. | Re-seed (responsibility of USGS) | | |

Specifications of marker sign

Damon, could you arrange a metal sign, 12" x 16" x 1/4" thick. Have 2 loops of pipe welded to the back so it can be pressed into cement. Have the following welded into it:

ALPINE FEDERAL #1 WELL SITE
33° 53.9' North Latitude
109° 09.3' West Longitude

To: Oil and Gas Conservation Commission
c/o Oil and Gas Program Administrator
Arizona Geological Survey
845 North Park Avenue, Suite 100
Tucson, AZ 85719



This is to advise you that the Geothermal Studies Project of the U.S. Geological Survey will accept the abandoned geothermal exploration well, known as the **Alpine #1 Federal**, located on the NW 1/4 of the SW 1/4 of Section 23, Township 6N, Range 30E, County of **Apache**, Arizona, as an observation well to be used for scientific purposes.

Further, the Geothermal Studies Project of the U.S. Geological Survey will accept full responsibility for the proper maintenance and use of the above well, including its final plugging, in full compliance with the Rules adopted by the Oil and Gas Conservation Commission.

I further understand that the Geothermal Studies Project of the U.S. Geological Survey is responsible for compliance with the provisions of the State Water Code, Chapter 1, Title 45, Arizona Revised Statutes and with any applicable requirements of the U.S. Geological Survey, Bureau of Land Management and U.S. Forest Service.

Signature

Thomas H. Moses, Jr.
Address 345 Middlefield Road
Menlo Park, CA 94025

State of California
County of San Mateo

On this, the 6th day of May, 1994, before me Fina
Whitley, the undersigned officer, personally appeared
Thomas H. Moses, Jr., known to me (or satisfactorily proven) to be
the person whose name is subscribed to the within instrument and
acknowledged that he executed the same for
the purpose stated therein contained.

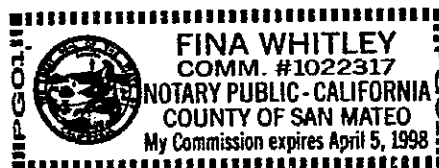
In witness whereof I hereunto set my hand and official seal.

Notary Public

My commission expires

4-5-98

Permit Number 878



Form 3260-3
(formerly 9-1958)
(June 1988)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
GEOTHERMAL SUNDRY NOTICE

FORM APPROVED
OMB NO. 1004-0132
Expires: September 30, 1990

The Bureau of Land Management (BLM) requests this form or other BLM-approved forms to be prepared and filed in triplicate with requisite attachments with the authorized officer. The authorized officer must approve this permit prior to any lease operations.

6. Lease Serial No. N/A	
7. Surface Manager: <input type="checkbox"/> BLM <input checked="" type="checkbox"/> FS <input type="checkbox"/> Other	
8. Unit Agreement Name N/A	
9. Well No. Alpine #1	10. Permit No. N/A
11. Field or Area Alpine	
12. Sec., T., R., B. & M. Sec 23, T6N, R30E	
13. County Apache	
14. State Arizona	

1a. Well Type: ☐ Production ☐ Injection ☐ Heat Exchange ☒ Observation ☐ Other

1b. Well Status:

P & A plan approval

2. Name of Lessee/Operator

Tonto Drilling Services, Inc.

3. Address of Lessee/Operator

2200 South 4000 west, Salt Lake City, UT 84120

4. Location of Well or Facility 35-23 surface 35-23TD Ground Elevation 8555.6

T6N, R30E, SEC23 1153 WL 2122 SL

5. Type of Work

- | | | |
|---|---|---|
| <input checked="" type="checkbox"/> Change Plans | <input type="checkbox"/> Convert to Injection | <input type="checkbox"/> Pull or Alter Casing |
| <input type="checkbox"/> Site and Road Construction | <input type="checkbox"/> Fracture Test | <input type="checkbox"/> Multiple Complete |
| <input type="checkbox"/> Construct New Production Facilities | <input type="checkbox"/> Shoot or Acidize | <input checked="" type="checkbox"/> Abandon |
| <input type="checkbox"/> Alter Existing Production Facilities | <input type="checkbox"/> Repair Well | <input type="checkbox"/> Other |

15. Describe Proposed Operations (Use this space for well activities only. See instructions for current well conditions on reverse)

- (1) Pull NQ rods or cut NQ rods below 550 feet and retrieve upper 550 feet.
- (2) Place cement plug from 550 feet to 450 feet across surface casing shoe at 500 feet.
- (3) Place cement plug from surface to 50 feet depth.
- (4) Cut casing just below surface and cover with soil.
- (5) Restore site according to USFS specifications.

16. Describe Proposed Operations (Use this space for all activities other than well work)

N/A

17. I hereby certify that the foregoing is true and correct

Signed

Title VICE PRESIDENT & GENERAL MANAGER

Date

11/19/93

(This space for Federal use)

Approved by

Title

Date

Conditions of Approval, if any:

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

(Instructions on reverse)

Form 3260-3
(formerly 9-1958)
(June 1988)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
GEOTHERMAL SUNDRY NOTICE

FORM APPROVED
OMB NO. 1004-0132
Expires: September 30, 1990

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1a. Well Type: ☐ Production ☐ Injection ☐ Heat Exchange ☒ Observation ☐ Other

1b. Well Status: Completion as a temporary observation well

2. Name of Lessee/Operator
Tonto Drilling Services, Inc.

3. Address of Lessee/Operator
2200 South 4000 West, Salt Lake City, UT 84120

4. Location of Well or Facility 35-23 surface 35-23 TD
Ground Elevation 8555.6
T6N, R30E, SEC 23 1153 WL 2122SL

5. Type of Work
☒ Change Plans ☐ Convert to Injection ☐ Pull or Alter Casing
☐ Site and Road Construction ☐ Fracture Test ☐ Multiple Complete
☐ Construct New Production Facilities ☐ Shoot or Acidize ☐ Abandon
☐ Alter Existing Production Facilities ☐ Repair Well ☐ Other

15. Describe Proposed Operations (Use this space for well activities only. See instructions for current well conditions on reverse)
- (1) At 3,369 feet the HQ rods were differentially stuck (Attachment A, B)
 - (2) The HQ rods were cemented from 2500 to 3369 feet (Attachment B)
 - (3) From 3369 feet to total depth (4505 feet) the borehole is NQ size (see Attachment B)
 - (4) HQ rods from surface to 2500 feet were retrieved (see Attachment B)
 - (5) A bottom-capped NQ string was inserted into the borehole from the surface to 4505 feet (T.D.) as a temporary observation completion (see Attachment B)
 - (6) Install a secure temporary well head for geophysical logging.

Attachment A - monthly drilling reports for July and August
Attachment B - diagram of temporary observation well completion

16. Describe Proposed Operations (Use this space for all activities other than well work)

N/A

17. I hereby certify that the foregoing is true and correct

Signed

Title VILE PRESIDENT & GENERAL MANAGER

Date 11/17/93

(This space for Federal use)

Approved by

Title

Date

Conditions of Approval, if any:

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

(Instructions on reverse)

PHOENIX, ARIZONA

9:00 A.M.

DEC 6 '93

RECEIVED
BLM AZ STATE OFFICE

A

JULY MONTHLY REPORT SWTDI/NMSU
PERIOD 7/1/93 - 7/31/93
TONTA/ALPINE #1/FEDERAL

DRILLING OPERATIONS

Award of the Alpine #1/Federal drilling contract was given on 4/1/93 to Tonto Drilling Services of Salt Lake City, Utah. In coordination with Tonto and the Arizona Department of Commerce all permits from Federal and State agencies were acquired and a Plan of Exploration Operations and a Geologic Logging and Core Marking Plan were prepared by Tonto's geotechnical subcontractor, Southwest Technology Development Institute, New Mexico State University, Las Cruces, New Mexico, between 4/1/93 and 7/1/93. The Tonto drill rig began moving on to the site on 7/1/93. However, drilling start-up was delayed by the refusal of a subcontracted truck driver to unload the substructure and mud tank on location. The truck driver claimed that the first turn on the access road from the highway was too narrow. However, other trucks of the same size and the drill rig managed to negotiate the turn on this former logging road with no problem. Start-up was also delayed by the failure of Tonto's crane on 3 July, 1993, just before the 4th of July. On 7/7/93 the borehole was spudded. By 7/13/93, 500 feet of surface casing was cemented and the blowout prevention equipment (BOP) nipped-up and tested. Surface-casing cementing and BOP testing was witnessed and approved by the Arizona Oil and Gas Administrator and the U. S. Bureau of Land Management. Drilling operations have been exceptionally smooth except for some initial problems with rig hydraulics. The hydraulics problems were solved by Tonto field crews in the first few days. An occasional problem with the core catcher in the core tube has resulted in minor core slippage. However, core recovery has been practically 100 percent. Overall performance of the Tonto forman, drillers, and helpers has been excellent.

Total depth of the Alpine#1/Federal test borehole was 2,966 feet as of midnight 7/31/93. The daily footage rate averaged about 137 feet per day for the period between 7/13/93 and 7/31/93. Footage rates for the period 7/14/93 to 7/19/93 averaged 178 feet per day and dropped to 131 feet per day between 7/21/93 and 7/28/93. Between 7/29/93 and 7/31/93 the daily footage rate decreased to 74 feet per day as the lower sections of the Paleocene-Eocene Baca Formation were penetrated. Circulation was not lost to the formation at any time during drilling in July.

Daily communications (as needed) and weekly communications with Federal and State regulators has been maintained throughout the July project period. The U. S. Forest Service has assisted in locating a drilling-mud disposal site very close to the drilling location.

TEMPERATURE

A ten minute bottom-hole temperature (BHT) at 2,851 feet was 129 degrees F. This temperature was not an equilibrium rock temperature because of cooling by drill mud circulation. A mercury maximum thermometer inside a capped steel pipe bomb, mounted on the overshot, was used to obtain the BHT temperature. Return mud temperatures at the surface were averaging about 78 degrees F for the interval between 2,334 and 2,774 feet.

GEOLOGY

The Tertiary Datil Group was encountered from the surface to 1,093 feet depth. From 1,093 feet to 2,966 feet the Tertiary Baca Formation is identified. The top of the Baca is picked at the top of a major conglomerate unit. The top of the conglomerate unit contains the first occurrence of red granite (Precambrian ? clasts).

The Datil Group consists mostly of epiclastic volcanic mudflows and volcanic arenites and conglomerates. Between 854 feet and 942 feet, a dark blue-green to gray blue-green andesite porphyry flow-breccia is interbedded in the Datil sequence. This unit is probably a toe breccia peripheral to an andesite flow mapped at the surface along the northern and eastern flanks of Escudilla Mountain. An orange-brown rhyolite lithic-crystal ash-flow tuff between 1,018 feet and 1,038 feet is the only other volcanic flow encountered in the Datil Group. The ash-flow tuff probably represents the distal outflow from an Oligocene silicic cauldron or silicic dome complex tens of miles southeast and south of the Alpine #1 location.

The upper member of the Baca Formation from 1,093 feet to 1,266 feet consists of a sandy, granule-to-cobble conglomerate interbedded with coarse-to-medium sandstone and pebbly sandstone. The conglomerates are mainly matrix-supported and contain well-rounded to subrounded clasts of silicic and intermediate volcanics, limestone, red jasper (Precambrian ?), and red granite (Precambrian ?). From 1,266 feet to 1,325 feet the Baca consists of siltstone that coarsens downward into fine-to-medium sandstone and pebbly sandstone and pumaceous fine-to-medium sandstone. The Baca consists of interbedded matrix-supported granule-to-cobble conglomerate and medium-to-coarse sandstone between 1,325 feet and 1,358 feet. From 1,358 feet to 2,966 feet the Baca consists of mostly siltstone and fine-to-medium sandstone with minor interbedded conglomerates and red-brown mudstone. The conglomerate and red-brown mudstone become more abundant below 2,850 feet depth.

Above 1,580 feet, altered pumice lapilli are sometimes observed and many sandstones are noticeably pumaceous. At 1,438 feet, a 2-to-3 inch thick air-fall tuff with distinct biotite crystals was encountered. Below 1,580 feet, the Baca becomes predominantly an arkosic litharenite, showing bioturbation, parallel laminations, some ripple cross-lamination, flaser structures, some soft sediment deformation, very thin-to-medium bedding, weak pedogenic and diagenetic calcite, and root casts.

The interval from 1,093 feet to 1,580 feet in the Baca probably records the initiation of silicic volcanism which culminated in the Oligocene 'ignimbrite flareup' in the Datil-Mogollon volcanic field to the south and southeast of the Alpine #1 location. The conglomerate at the top of the Baca (1,093 feet to 1,266 feet) may indicate thermal tumescence preceding the Oligocene volcanism, reactivation of older Laramide basement-involved structures, and/or onset of a dryer climate.

BRIEF WELL HISTORY

- 7/1/93 Drilling equipment, rig, and supplies mobilizing from Tonto Drilling yard in Salt Lake City. Drill rig moved on to the Alpine Divide site (1500 hrs), begin rigging-up (1500-1900 hrs). USFS, USBLM, and AZGS officials alerted.
- 7/2/93 Supply trucks arrive at site entrance (0900 hrs). Truck with mud tanks and substructure refuse to make sharp turn off highway on to the logging road access to drill site. Mud tanks and substructure unloaded at sawmill in Nutrioso. Backhoe, parts trailer, and crane arrive on site (1130 hrs). Drill pad constructed and mud tanks dug. Water tank from Farmington arrives (1645 hrs).
- 7/3/93 Rigging-up continues (0700-1900 hrs). Tonto crane brakes down, unable to move substructure onto site. Unable to find mechanic for crane or a replacement crane due to 4th of July holiday weekend. John Hass (USBLM) and Bob Dyson (USFS) visit site (1649 hrs).
- 7/4/93 No activity.
- 7/5/93 Rigging-up continues (0700-1330 hrs). Rental crane acquired.
- 7/6/93 Rigging-up continues (0700-1900 hrs). Substructure and last of equipment arrive on site (1100 hrs).

- 7/7/93 Continue rigging-up (0700-1200 hrs). Nipple-up mud tanks, mix mud, transfer mud from mixing tank to mud tank, rack casing and drill pipe, make-up drill string. Spud hole with 7 7/8 inch tricone (1200 hrs). Complete drilling 20 feet (1240 hrs). Rig hydraulics malfunction (1245 hrs). WOP (1245-2400 hrs).
- 7/8/93 WOP (0000-0600 hrs). Repair hydraulics and perform rig maintenance (0600-0708 hrs). Run surface casing and begin mixing cement (0738 hrs). Cementing conductor casing with good returns (0752-0802 hrs), WOC (0802-1600 hrs). Tag cement (1613 hrs), drill-out cement (1650 hrs). Rotary with 5 7/8 inch tricone bit from 20 to 193 feet (1650-2400 hrs). Samples collected at 10 feet intervals.
- 7/9/93 Rotary 5 7/8 inch tricone from 193 to 465 feet (0000-2400 hours. Samples collected at 10 feet intervals. Trip-out, change bit, trip-in (0154-0345 hrs). John Sass (USGS), Tom Moses (USGS), and Frank Grubb (USGS) on location (0800-0925 hrs). Frank Mancini (AZDC) and Jack Haenichen (AZDC) on location (0823-0920 hrs). Maintenance on rig hydraulics (1500-1600 hrs).
- 7/10/93 Rotary 5 7/8 inch tricone from 465 to 502 (0000-0730 hrs). Condition hole and trip-out (0730-0830 hrs). Run 500 feet of surface casing with centralizers (0830-1230 hrs). Circulate and flush mud from hole (1230-1330 hrs). Begin mixing cement, nipple-up cement head (1330-1500 hrs). Pump cement (1525 hrs) and drop plug and displace cement (1530 hrs). Plug fails to drop and cement job fails (1540 hrs). Adjust cement head and plug, begin to mix second batch of cement (1625 hrs), pump cement (1651 hrs). Drop plug and displace cement (1700 hrs), good cement returns (1710 hrs). Cement job witnessed by John Hass (USBLM) and Steve Rauzi (AZGS). WOC (1710-0000 hrs).
- 7/11/93 WOC (0000-2300 hrs). Nipple-up and test BOP (0700-2300 hrs). Rig maintenance and repair hydraulics (2330-2400 hrs). Complete nipple-up of double gate (1330 hrs). Successful test of manifold valves on blooie line to 1,000 psi (1626 hrs). Successful test of choke valve to 1,000 psi (1639 hrs). Pipe ram and blind ram successfully tested to 1,000 psi (1645 hrs). H & H hotshot arrives from Farmington with BOP bolts for the annular BOP flange. Nipple-up annular (1845 hrs). Test annular to 1,000 psi, leaking at flange (1858 hrs). Tighten BOP bolts, retest 1,000 psi, still leaking (1918 hrs). Replace flange, retest to 1,000 psi, still leaking (1216 hrs). Tighten BOP bolts and retest. Successful annular BOP test to 1,000 psi (2216 hrs). All BOP tests witnessed by John Haas (USBLM) and Steve Rauzi (AZGS). Make-up and run drill string with 3 7/8 inch tricone bit. Charge pump for hydraulics fails (2330 hrs).
- 7/12/93 Install and test hydrogen sulfide sniffer, alarms, and wind sock (0700 2300 hrs). WOP (0000-2300 hrs). Cleaned location and performed rig maintenance. Drill helper sprains foot (2300 hrs), taken to hospital.
- 7/13/93 Tagged cement 478 feet. Drill-out float shoe and plug (0800-0830 hrs). Successfully test surface-casing cement to 1,000 psi at 495 feet (0830-0850 hrs). Make-up core barrel and circulate plug rubber from the hole (0850-0940 hrs). Trip-in core barrel and diamond core bit (0940-1045 hrs). Coring from 497 to 564 feet (0940-2400 hrs).
- 7/14/93 Coring from 564 to 734 feet (0000-2400 hrs).
- 7/15/93 Coring from 754 to 914 feet (0000-2400 hrs). Harris Crosby of Nutrioso visits site (1625-1705 hrs)
- 7/16/93 Coring from 914 to 1,104 feet (0000-2400 hrs). Trip-out, change bit, trip-in (0300-0435 hrs).

7/17/93 Coring from 1,104 to 1,274 feet (0000-2400 hrs). Mix new mud at 1,174 feet, anchor blooie line manifold and choke valves and perform rig maintenance 0923-1207 hrs).

7/18/93 Coring from 1,274-1,454 feet (0000-2400 hrs). Diaphram pump down, replace with centrifigal mud pump at 1,380 feet (1528-1545 hrs).

7/19/93 Coring 1,454 to 1,634 feet (0000-2400 hrs). Nipple-up and test new accumulator at 1,553 feet (1245-1345 hrs).

7/20/93 Coring 1,634 to 1,694 feet (0000-2400 hrs). Trip-out, change bit, trip-in (0535-0850 hrs). Shut down at 1,694 feet, haul old mud, haul water, mix new mud (1244-2318 hrs).

7/21/93 Coring 1,694 to 1,849 feet (0000-2400 hrs). Bob Dyson (USFS) visits site (0900-0920 hrs). Jim Witcher (SWTDI/NMSU) gives geothermal talk to Alpine Chamber of Commerce (1900-2130 hrs).

7/22/93 Coring 1,849 to 2,002.5 feet (0000-2400 hrs). Daniel Sanchez and Niles Lackey (USDOE-Albuquerque), John Sass (USGS-Flagstaff), John Crawford (AZDC, consultant), Frank Mancini (AZDC), and John Hoskins (AZDOT) visit the site (1300-1530 hrs).

7/23/93 Coring 2,002.5 to 2,134 feet (0000-2400 hrs). Daniel Sanchez and Niles Lackey (USDOE-Albuquerque), John Sass (USGS-Flagstaff), John Crawford (AZDC, consultant), Frank Mancini (AZDC), and John Hoskins (AZDOT) visit the site (0830-0930 hrs).

7/24/93 Coring 2,134 to 2,244 feet (0000-2400 hrs). Repair diaphram mud pump at 2,204 feet (1513-1613 hrs).

7/25/93 Coring 2,244 to 2,374 feet (0000-2400 hrs).

7/26/93 Coring 2,374 to 2,509.5 feet (0000-2400 hrs). Rig maintenance (0730-0830 hrs).

7/27/93 Coring 2,509.5 to 2,614 feet (0000-2400 hrs). Trip-out, change bit, trip-in at 2,544 feet (0550-0940 hrs).

7/28/93 Coring 2,614-2,744 feet (0000-2400 hrs).

7/29/93 Coring 2,744-2,820.5 feet (0000-2400 hrs). Stuck core barrel 2,784 feet (0900-1022 hrs).

7/30/93 Coring 2,820.5 to 2,912 feet (0000-2400 hrs).

7/31/93 Coring 2,912 to 2,966 feet (0000-2400 hrs). Trip-out, add 20 foot core barrel, change bit, trip-in (0330-0950 hrs). Conditional hole 2922 feet (1021-1115 hrs).

CORE FOOTAGE SUMMARY

Date	Feet/Day	Remarks
7/13	67	coring begins
7/14	190	
7/15	160	
7/16	190	change bit
7/17	170	
7/18	180	
7/19	180	
7/20	60	change bit
7/21	155	
7/22	153.5	
7/23	131.5	
7/24	110	
7/25	130	
7/26	135.5	
7/27	104.5	change bit
7/28	130.0	
7/29	76.5	
7/30	91.5	
7/31	54	change bit

BOTTOM-HOLE TEMPERATURE

Depth (feet)	Temperature (F)
2244	111
2294	119
2344	122
2394	128
2444	129
2494	128
2594	140 (no circ 3 hrs)
2590	134
2642	132
2714	129
2774	130
2820	129
2851	129
2922	139 (no circ 7 hrs)

RETURN MUD TEMPERATURE AT SURFACE

Depth (feet)	Temperature (F)	Depth (feet)	Temperature (F)
854	72	1669	70
885	73	1824	67
904	72	1907	72
920	71	1920	76
1002	69	2184	74
1023	69	2214	76
1064	70	2234	76
1094	70	2334	78
1210	70	2720	78
1252	70	2774	78
1308	68		
1326	67		
1512	70		
1553	74		
1563	75		
1565	76		
1577	75		

FORMATION SUMMARY

Formation	Top (depth in feet)	Bottom (depth in feet)	Thickness (depth in feet)
Tertiary Datil Group	0	1093	1093
Tertiary Baca Fm	1093	2966+	1873+

AUGUST MONTHLY REPORT SWTDI/NMSU
PERIOD 8/1/93 -8/31/93
TONTON/ALPINE #1/FEDERAL

DRILLING OPERATIONS

Core penetration decreased substantially during the first half of August as compared to the rates in July. Rates were generally less than 50 feet per day, compared to more than 100 feet per day in July. Depth of drilling played some role in the rate decrease; however, the nature of the lower Baca Formation was the primary cause of penetration rate reduction. The sandy clay and clayey sand in matrix-supported and weakly-indurated conglomerate and gravels in the basal Baca Formation from about 2,700 feet to about 3,140 feet were easily washed-out and contributed to formation caving problems and maintenance of proper drilling-fluid viscosity and efficient cuttings and sand removal.

Rather than reduce from HQ to NQ coring at the base of the Baca and place the bad formation behind cement and the HQ drill string, it was decided to continue coring HQ until the base of the Cretaceous was reached to insure that the reduction was not premature. Prior to actual drilling, the Permian San Andres/Kaibab and Glorieta/Coconino Formations were identified as potential problem zones for drilling that could require reduction from HQ to NQ core. Regional geology indicated that one or both of the upper Permian units could be missing and that the Cretaceous units, if present, would rest upon the Permian/Pennsylvanian Supai. A reduction from HQ to NQ core was forced by the drill string becoming differential stuck while retrieving a core run with the last Cretaceous footage.

Drilling rates increased dramatically after the NQ reduction and the bad formation in the lower Baca was cemented behind the HQ rods. NQ core rates for the lower 750 feet of the Alpine 1/Federal averaged about 100 feet per day. A 100 feet per day coring-rate at depths below 3,500 feet is generally regarded as excellent, especially considering the time to pull the core tube, retrieve the core, and then send the tube back to bottom in order to resume coring.

Some lost circulation zones were encountered in the San Andres and Glorieta Formations. However, full and partial returns were maintained during most of the August drilling by conditioning the hole with lost circulation material (LCM) slugs at the end of core runs where circulation was lost.

Total depth was reached on the 29th of August and the hole was completed as a temporary observation hole by 31 August, 1993. The NQ rods were left in the hole to function as temperature observation tubing and to provide a contingency for re-entry to deepen the Alpine 1/Federal to Precambrian basement (see attached letter from James C. Witcher, SWTDI/NMSU to Steven Rauzi, AZGS).

Core recovery for the Alpine 1/Federal hole exceeded 99.5 percent. Overall performance of the Tonto formen, drillers, and helpers was outstanding. Daily communications (as needed) and weekly communications with Federal and State regulators was maintained throughout the August project period.

TEMPERATURE

Bottom-hole temperatures (BHT) generally increased from 128 F at 2,996 feet to 164 F at 4,505 feet. However, these temperatures are not equilibrium-rock temperatures because of cooling by drill mud circulation. A mercury maximum thermometer inside a capped, steel pipe bomb, mounted on the wireline overshot, was used to obtain the BHT temperature at the end of selected core runs, at roughly 50 feet increments apart.

Return mud temperature at the surface actually decreased from 78 F average in July and early August, while drilling with the HQ string, to about 65 F, while drilling with the NQ drill string. Differences in

heat transfer and operating modes with NQ core versus HQ core are responsible for the temperature decrease rather than formation geothermal causes.

GEOLOGY

The Tertiary Datil Group (?) was encountered from the surface to 1,093 feet depth. Datil units near the surface may actually be a facies of the Miocene Bidahochi or Fence Lake Formations. From 1,093 feet to 2,966 feet the Tertiary Baca Formation is identified. The top of the Baca is picked at the top of a major conglomerate unit. The conglomerate unit contains the first occurrence of red granite (Precambrian ? clasts). The Datil Group consists mostly of epiclastic volcanic mudflows and volcanic arenites and conglomerates. Between 854 feet and 942 feet, a dark blue-green to gray blue-green andesite porphyry flow-breccia is interbedded in the Datil sequence. This unit is probably a toe-breccia, peripheral to an andesite flow mapped at the surface along the northern and eastern flanks of Escudilla Mountain. An orange-brown rhyolite lithic-crystal ash-flow tuff between 1,018 feet and 1,038 feet is the only other volcanic flow encountered in the Datil Group. The ash-flow tuff probably represents the distal outflow from an Oligocene silicic cauldron or silicic dome complex tens of miles southeast and south of the Alpine #1 location.

The upper member of the Baca Formation from 1,093 feet to 1,266 feet consists of a sandy, granule-to-cobble conglomerate interbedded with coarse-to-medium sandstone and pebbly sandstone. The conglomerates are mainly matrix-supported and contain well-rounded to subrounded clasts of silicic and intermediate volcanics, limestone, red jasper (Precambrian ?), and red granite (Precambrian ?). From 1,266 feet to 1,325 feet the Baca consists of siltstone that coarsens downward into fine-to-medium sandstone and pebbly sandstone and pumaceous fine-to-medium sandstone. The Baca consists of interbedded matrix-supported granule-to-cobble conglomerate and medium-to-coarse sandstone between 1,325 feet and 1,358 feet. From 1,358 feet to 2,966 feet the Baca consists of mostly siltstone and fine-to-medium sandstone with minor interbedded conglomerates and red-brown mudstone. The conglomerate and red-brown mudstone become dominant from about 2,850 feet to 3,139 feet depth. Above 1,580 feet, altered pumice lapilli are sometimes observed and many sandstones are noticeably pumaceous. At 1,438 feet, a 2-to-3 inch thick air-fall tuff with distinct biotite crystals was encountered. Below 1,580 feet, the Baca becomes predominantly an arkosic litharenite, showing bioturbation, parallel laminations, some ripple cross-lamination, flaser structures, some soft sediment deformation, very thin-to-medium bedding, weak pedogenic and diagenetic calcite, and root casts. The interval from 1,093 feet to 1,580 feet in the Baca probably records the initiation of silicic volcanism which culminated in the Oligocene 'ignimbrite flareup' in the Datil-Mogollon volcanic field to the south and southeast of the Alpine #1 location. The conglomerate at the top of the Baca (1,093 feet to 1,266 feet) may indicate thermal tumescence preceding the Oligocene volcanism, reactivation of older Laramide basement-involved structures, and/or onset of a dryer climate, and/or reworking of lower Baca gravel units. The gravels rich in Precambrian lithologies at the base of Baca represent the uplift and unroofing of basement-cored uplifts associated with the later phases of the Laramide Orogeny in east central Arizona. In any case, the 2,046 feet of section section Baca encountered in the Alpine 1/Federal core hole is one the thickest in Arizona or New Mexico. The gradational nature of the Datil and Baca formations and differences in where the Baca Formation top is picked provide ambiguity on which sections are the thickest. Steve Cather, in New Mexico, picks the top of the Baca where volcanic clasts disappear, while Andre Potochnik, in Arizona, picks the top of the Mogollon Rim Formation, a Baca equivalent, where volcanic clasts roughly equal Precambrian basement clasts. The Cather and Potochnik criteria require thin-section analysis and neither criteria are easily applied to field studies. The criteria used to pick the top in the Alpine 1/Federal well is mappable in the field.

At 3,139 feet depth, the basal Baca conglomerate rests unconformably upon a brick red and orange siltstone and fine-to-medium silty sandstone with a calcite cement. This orange sandstone is informally designated as the 'LaOrange formation.' Potochnik describes a similar unit between the Mogollon Rim Formation and Cretaceous sandstone south of Show Low about 35 miles west of the Alpine 1/Federal site. The depositional setting the the LaOrange formation is much different than the overlying Baca Formation

and minor granule-to-cobble conglomerate beds suggest a much different provenance also. Clasts in the LaOrange are predominantly limestone, with minor intermediate volcanic porphyry clasts, as opposed to gravels rich in Precambrian plutonic and metamorphic clasts. The LaOrange shows both parallel and cross laminations and some ripple cross-laminated zones. The base of the LaOrange shows possible uranium mineralization, much dark carbonaceous material and a 1.5 inch thick bed of 'lignite' at 3,254.5 feet depth. The occurrence of intermediate volcanic clasts may indicate a Late Cretaceous to early Tertiary (early Laramide Orogeny) age. It is possible that the LaOrange is a southern Colorado Plateau equivalent to early Laramide units, the Fort Crittenden and Ringbone Formations, in the Basin and Range of southeastern Arizona and southwestern New Mexico.

Unconformably below the LaOrange formation is a carbonaceous medium-to-coarse sandstone with calcitic and dolomitic (?) cement. This unit is tentatively correlated with Cretaceous Dakota Formation. In the Alpine 1/Federal core hole, the Dakota is cross laminated and has abundant ripple cross-laminated zones with much carbonaceous laminae in ripple troughs. This unit is a light-gray, dark-gray and black, moderately well-sorted, quartz arenite. Marcasite is abundant, especially in association with carbonaceous-rich zones. Some of the carbonaceous material, where carbonate cements are lacking, in ripple troughs, and in coarse sand laminae, may represent 'dead oil.'

The Permian San Andres limestone is a finely crystalline, medium-to-dark gray, and brown limestone with predominant mudstone and uncommon wackestone textures. The San Andres micrites and crinoid biomicrites have black parallel and wavy laminations and dark sutured stylolites are common. Oily films are present along stylolite and fracture surfaces. Vertical fractures and minor small-scale vugs, partially filled with calcite crystals, are common. Several fractures, no doubt, contributed to lost circulation during coring. The lower 3 feet of the San Andres, just above the Glorieta Formation, is a probable solution-collapse breccia with a black shale and dark micrite matrix, possibly rich in carbonaceous material.

The Permian Glorieta sandstone consists of medium-to-fine, well-sorted, light gray and white sandstone with wavy and parallel laminations, ripple cross laminations, cross laminations, and cross bedding. Calcite, quartz, and dolomite (?) cement is present. Reduction spots, generally less than 0.5 inch diameter, contain marcasite, vitrinite and other carbonaceous material. Marcasite and black carbonaceous material is also common along many wavy laminations. Healed and opened high-angle fractures are present. Open fractures contain calcite crystals and appear to have contributed to lost circulation, especially between 3,455 and 3,465 feet depth. Intergranular porosity is indicated by drill mud sieving (ie mud buildups) on outer core surfaces, except on darker gray "reduction spots." Contact between the Glorieta Formation and the underlying Yeso Formation is obscured by a basalt intrusion, a probable dike of late Tertiary age.

The upper 35 feet of the Permian Yeso Formation is characterized by a solution-collapse or rubble breccia. Anhydrite dominates the Yeso between 3,788 and 3,905 feet depth. Massive, laminar, nodular, and mosaic anhydrite textures are present. Dark gray-to-brown siltstone, sandstone, and sandy dolomite are interbedded in the anhydrite. Bioturbation, rip-up clasts, and scour troughs are common. Soft sediment deformation, along with possible dewatering structures or enterolithic structures are present. A coastal sabka depositional environment is indicated. Between 3,905 and 4,158 feet, gray-to-dark brown and brown limestone and dolomite predominates over a few sandstone and anhydrite beds less than 5 to 15 feet thick. The mostly micritic limestones and dolomites show wavy laminations, bioturbation, flaser, soft sediment deformation. Many units are sandy, while others have blue-gray anhydrite nodules. Light-brown to dark brown, muddy, fine sandstone to siltstone with wavy bedding and laminations, some cross laminations, bioturbation, and soft sediment deformation occurs between 4,158 and 4,226 feet depth. Brown microcrystalline dolomite to calcareous dolomite and some interbedded blue-gray anhydrite occurs between 4,226 and 4,260 feet. Some of the dolomite at 4,228 to 4,231.5 feet is weakly fetid. Finely crystalline, dark gray-to-black, biomicrite and micrite with possible fusulinids is found between 4,362 and 4,408 feet depth. Between 4,399 and 4,402 feet depth dolomitic units show some oily films and staining. The majority of the cored Yeso Formation from 4,402 to 4,454 feet depth is a brown very-fine sandstone to siltstone.

BRIEF WELL HISTORY

- 8/1/93 Coring from 2,966 to 3,016 feet (0000-2400 hrs).
- 8/2/93 Coring from 3,016 to 3,054 feet (0000-2130 hrs). Change-out old mud, mix new mud (1100-1255 hrs). Trip-out, change bit (2130-2400 hrs).
- 8/3/93 Bit change continues, trip-in, chase cave at 3,046 to 3,054 feet, 1.5 feet cave recovered (0000-0030 hrs). Coring from 3,054 to 3,096 feet (0358-2400 hrs).
- 8/4/93 Coring from 3,096 to 3,155 feet (0000-2400 hrs). Clean drill cuttings from mud pits with backhoe (1030-1130 hrs).
- 8/5/93 Coring from 3,155 to 3,207 feet (0000-1839 hrs). No core retrieval on run 275, replace overshot (1740-1810 hrs), condition hole (1815-1828 hrs), retry to retrieve core tube (1828-1839 hrs), stuck tube (bent drill rod obstruction). Trip-out to retrieve tube and core, change bit and reamer shell (1921-2400 hrs), dented and bent rod replaced at 2,980 to 2,990 feet, probable cave (rods sticking while pulling out of hole (2,800 to 3,010 feet).
- 8/6/93 Trip-in, chase cave to bottom (0000-1235 hrs). Replace core catcher (1235-1320 hrs). Coring from 3,207 to 3,236 feet (1320-2400 hrs). Rods torque-up three times while coring run 276 from 3,216 to 3,236 feet (1838-2400 hrs).
- 8/7/93 Coring from 3,236 to 3,308 feet (0000-2400 hrs).
- 8/8/93 Coring from 3,308 to 3,337 feet (0000-1350 hrs). Pull-back rods 480 feet, condition hole, ream hole and chase cave back to bottom (1350-2400 hrs). Encountered cave bridges at 3,020 feet and from 3,036 to 3,039 feet.
- 8/9/93 Continue conditioning hole, reaming and chasing cave, 3 feet of cave recovered (0000-0320 hrs). Mix new mud, change-out old mud (1100-1430 hrs). Reaming back to bottom (1430-1820 hrs). Coring from 3,337 to 3,338 feet (1915-2145 hrs).
- 8/10/93 Coring from 3,338 to 3,352 feet (0000-2400 hrs).
- ↓ 8/11/93 Coring from 3,352 to 3,369 feet (0000-7333 hrs). Differential stuck at 3,369 feet (0733 hrs). Circulate detergent, try to work rods free (0800-2400 hrs).
- 8/12/93 Continue differential stuck at 3,369 feet, circulate detergent, try to work rods free (0000-1900 hrs). Nipple-down BOP, prepare for reduction from HQ to NQ (0700-1900 hrs). Run cement, HQ bit 10 feet from bottom at 3,360 feet (1930-2210 hrs). WOC (2210-2400 hrs).
- 8/13/93 WOC, prepare NQ string, nipple-up and test BOP (0000-1200 hrs). Trip-in NQ rods (0700-1200 hrs), tag cement at 3,294 feet, drill-out cement (1335-2400 hrs).
- 8/14/93 Continue to drill-out cement to 3,345 feet, no cement below HQ core-barrel landing ring, stuck NQ tube (0000-0122 hrs). Perform rig maintenance, change out mud, and haul water (0122-0350 hrs). Trip-out, and haul water (0350-0720 hrs). Free-up stuck tube and makeup wash rod (0720-0930 hrs). Trip-in wash rod (0930-1200 hrs). Wash and clean hole and prepare to cement (1200-1900 hrs). Run cement (1900-2130 hrs). WOC, trip-out (2130-2400 hrs).
- Change plans = reduce to NQ*

8/15/93 WOC, trip-in and wash-down hole (0000-0400 hrs). Tag cement at 3,200 feet, core cement (0400-1230 hrs). Mix new mud, change-out old mud (1415-1600 hrs). Coring from 3,369 to 3,399 feet (1230-2400 hrs).

8/16/93 Coring from 3,399 to 3,475 feet (0000-2400 hrs). Lost circulation from 3,415 to 3,475 feet, major open fractures in core at 3,459 and 3,462 feet. Lost circulation material (LCM) slugs at 3,415 feet (0400-0430 hrs), at 3,439 feet (1030-1135 hrs), and at 3,349 feet (1540-1710 hrs).

8/17/93 Coring from 3,475 to 3,515 feet (0800-2400 hrs). Condition hole and send LCM slug at 3,475 feet (0000-0800 hrs). Condition hole and send LCM slug at 3,515 feet (2100-2345 hrs).

8/18/93 Coring from 3,515 to 3,585 feet (0000-2400 hrs). Condition hole and send LCM slug at 3,535 feet (0400-0930 hrs).

8/19/93 Coring from 3,585 to 3,655 feet (0000-2400 hrs). Partial returns from 3,635 to 3,655 feet.

8/20/93 Coring from 3,655 to 3,725 feet (0000-2400 hrs). Partial returns from 3,655 to 3,685 feet. Pull-back rods 440 feet at 3,725 feet to condition hole and flush LCM and mud rings from drill string (2200-2400 hrs).

8/21/93 Continue to condition hole and ream to bottom (0000-0121 hrs). Coring from 3,725 to 3,775 feet (0121-1425 hrs). Differential stuck, circulate detergent and work rods free at 3,765 feet (1425-1510 hrs). Core barrel mismatch on run 328 from 3,765 to 3,775 feet, lost core (1510-1740 hrs). Trip-out from 3,775 feet (1820-2400 hrs).

8/22/93 Coring from 3,775 to 3,855 feet (0000-2400 hrs). Lost circulation from 3,815 to 3,835 feet (1600-2112 hrs). Condition hole, send LCM slugs at 3,185 feet (1445-1537 hrs), and at 3,835 feet (1940-2112 hrs). Perform maintenance on rig hydraulics at 3,805 feet (1225-1307 hrs).

8/23/93 Coring from 3,855 to 3,975 feet (0000-2400 hrs).

8/24/93 Coring from 3,975 to 4,085 feet (0000-2400 hrs).

8/25/93 Coring from 4,085 to 4,195 feet (0000-2400 hrs). Condition hole, circulate LCM slug at 4,135 feet (1045-1145 hrs) and at 4,145 feet (1400-1525 hrs).

8/26/93 Coring from 4,195 to 4,284 feet (0000-2400 hrs).

8/27/93 Coring from 4,284 to 4,375 feet (0000-2400 hrs). Rig maintenance at 4,355 feet (1740-1800 hrs).

8/28/93 Coring from 4,375 to 4,475 feet (0000-2400 hrs).

8/29/93 Coring from 4,475 to 4,505 feet, total depth (TD) at 4,505 feet (0000-0634 hrs). Rig maintenance (0652-0800 hrs). Wiper-run then trip-out from 4,505 feet (0830-1300 hrs). Nipple-down BOP (1300-1330 hrs). Test and trip-in cutter, make first cut at 2,700 feet on HQ rods (1345-1900 hrs). Pull-out of hole, rebuild cutter, trip-back, try two more cuts, pull-out, trip-back with new cutter (1900-2400 hrs).

8/30/93 Successful cut at 2,510 feet, pull 251 HQ rods, 85 HQ rods left in hole (0000-2400 hrs). Jim Witcher leaves Alpine with load of core for the AZGS depository in Tucson.

8/31/93 Trip-in 4,505 feet of greased-up NQ rods, capped at bottom and filled with clean water (0000-0700 hrs). Nipple-up well head, begin rigging-down and demobilization, temperature log bore hole through the NQ rods (0700-1900 hrs). Witcher delivers core to AZGS in Tucson.

**CORE FOOTAGE
SUMMARY**

Date	Feet/Day	Remarks
8/1	50	
8/2	38	bit change
8/3	42	chase cave to bottom
8/4	59	
8/5	52	rods torque up/bit change and dented drill rod replaced
8/6	29	chase cave to bottom/rods torque up
8/7	72	
8/8	29	pull back and condition hole/chase cave to bottom
8/9	1	bit change and two dented rods replaced/chase cave to bottom
8/10	14	
8/11	17	HQ string differential stuck/unable to free rods
8/12	0	cement/WOC/reduce to NQ string-bit change
8/13	0	WOC/drill-out cement
8/14	0	re-cement/WOC
8/15	30	drill-out cement/core NQ
8/16	76	lost circulation material (LCM) slugs
8/17	40	LCM slugs
8/18	70	LCM slugs
8/19	70	
8/20	70	
8/21	50	differential stuck/worked free/core barrel mismatch/bit change
8/22	80	LCM slugs
8/23	120	
8/24	110	
8/25	110	LCM slugs
8/26	89	
8/27	91	
8/28	100	
8/29	30	total depth (TD) (4505 feet)

BOTTOM-HOLE TEMPERATURE

Depth (feet) Temperature (F)

2996	128
3077	136
3114	124
3166	137
3207	131
3276	132
3326	134
3459	128
3515	125
3555	125
3605	130
3655	137
3705	136
3755	124
3805	134
3855	134
3905	149
3955	153
4005	155
4055	158
4105	159
4145	152
4205	155
4255	158
4304	160
4355	163
4405	163
4445	166
4505	164

RETURN MUD TEMPERATURE AT SURFACE

Depth (feet) Temperature (F)

3209	80
3338	74
3348	81
3392	72
3565	66
3655	65
3845	65
4055	69
4185	67
4474	62
4505	58

FORMATION SUMMARY

Formation	Top (depth in feet)	Bottom (depth in feet)	Thickness (depth in feet)
Oligocene (?) Datil Group (?)	0	1093	1093
Eocene/Paleocene Baca Fm	1093	3139	2046
Paleocene (?)/ Upper Cretaceous (?) 'La Orange fm'	3139	3260	121
Cretaceous Dakota (?) Fm	3260	3369	109
Permian San Andres Fm	3369	3436	67
Permian Glorieta Fm	3436	3636 to 3751	200 to 315
Permian Yeso	3636 to 3751	4454+	703+
Upper Tertiary (?) basalt intrusions (sills and/or dikes)	3636 4260 4327 4454	3751 4322 4362 4505	115 62 35 51

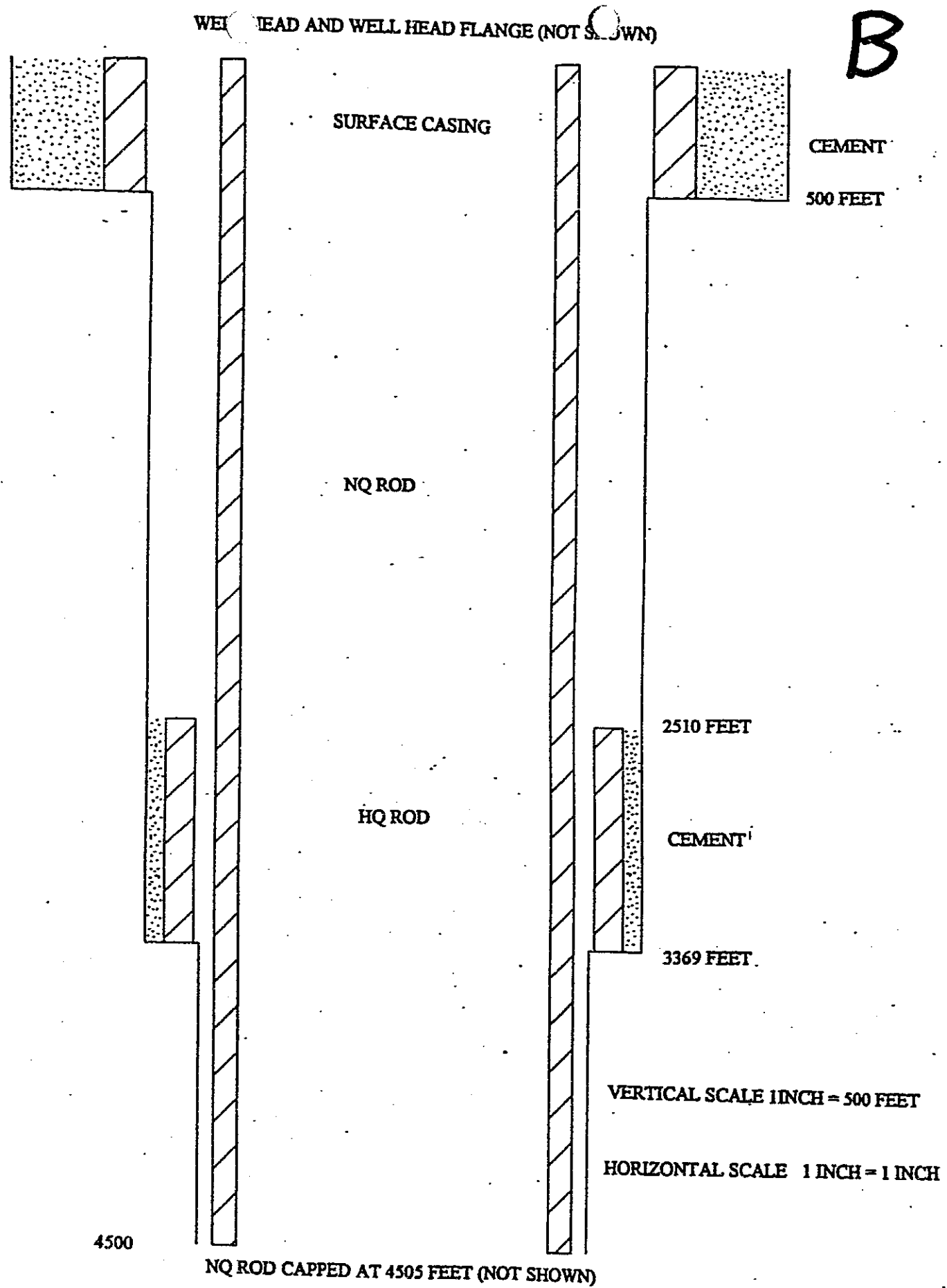


Table 14. Formation summary of the Alpine1/Federal borehole.

Tertiary Pueblo Creek Formation and Mogollon Rim formation	
0 to 3,139 feet	(0 to 957 m)
thickness	3,139 feet (957 m)
unnamed Tertiary (?) / Cretaceous (?) unit	
3,139 to 3,246 feet	(957 to 989 m)
thickness	107 feet (32 m)
Cretaceous Dakota (?) Sandstone	
3,246 to 3,362 feet	(989 to 1,025 m)
thickness	116 feet (36 m)
Permian San Andres Formation	
3,362 to 3,436 feet	(1,025 to 1,047 m)
thickness	74 feet (22 m)
Permian Glorieta Sandstone	
3,436 to 3,639 feet	(1,047 to 1,109 m)
thickness	203 feet (62 m)
Quaternary(?) / Tertiary (?) basaltic intrusion	
3,639 to 3,751 feet	(1,109 to 1,143 m)
thickness	112 feet (34 m)
Permian Corduroy member "Supai Formation" (Winters, 1963)	
3,751 to 4,266 feet	(1,143 to 1,298 m)
thickness	515 feet (157 m)
Quaternary(?) / Tertiary (?) basaltic intrusion	
4,260 to 4,322 feet	(1,298 to 1,317 m)
thickness	62 feet (19 m)
Permian Fort Apache Limestone member "Supai Formation" (Winters, 1963)	
4,322 to 4,327 feet	(1,317 to 1,319 m)
thickness	5 feet (2 m)
Quaternary(?) / Tertiary (?) basaltic intrusion	
4,327 to 4,362 feet	(1,319 to 1,330 m)
thickness	35 feet (11 m)
Permian Fort Apache Limestone member "Supai Formation" (Winters, 1963)	
4,362 to 4,405 feet	(1,330 to 1,343 m)
thickness	43 feet (13 m)
Permian Big A Butte member "Supai Formation" (Winters, 1963)	
4,405 to 4,454 feet	(1,343 to 1,358 m)
thickness	49 feet (15 m)
Quaternary(?) / Tertiary (?) basaltic intrusion	
4,454 to 4,505 feet	(1,358 to 1,373 m)
thickness	51 feet (15 m)

**ALPINE 1/FEDERAL
FINAL REPORT - PART 2
TEMPERATURE GRADIENTS, GEOTHERMAL POTENTIAL,
AND GEOLOGY**

Prepared for

**Arizona Department of Commerce
Energy Office
Phoenix, Arizona**

Prepared by

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June 1994

**Arizona Geological Survey
Contributed Report CR-94-F**

**ARIZONA GEOLOGICAL SURVEY
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**This report is preliminary and has not been edited or
reviewed for conformity with Arizona Geological Survey
standards**

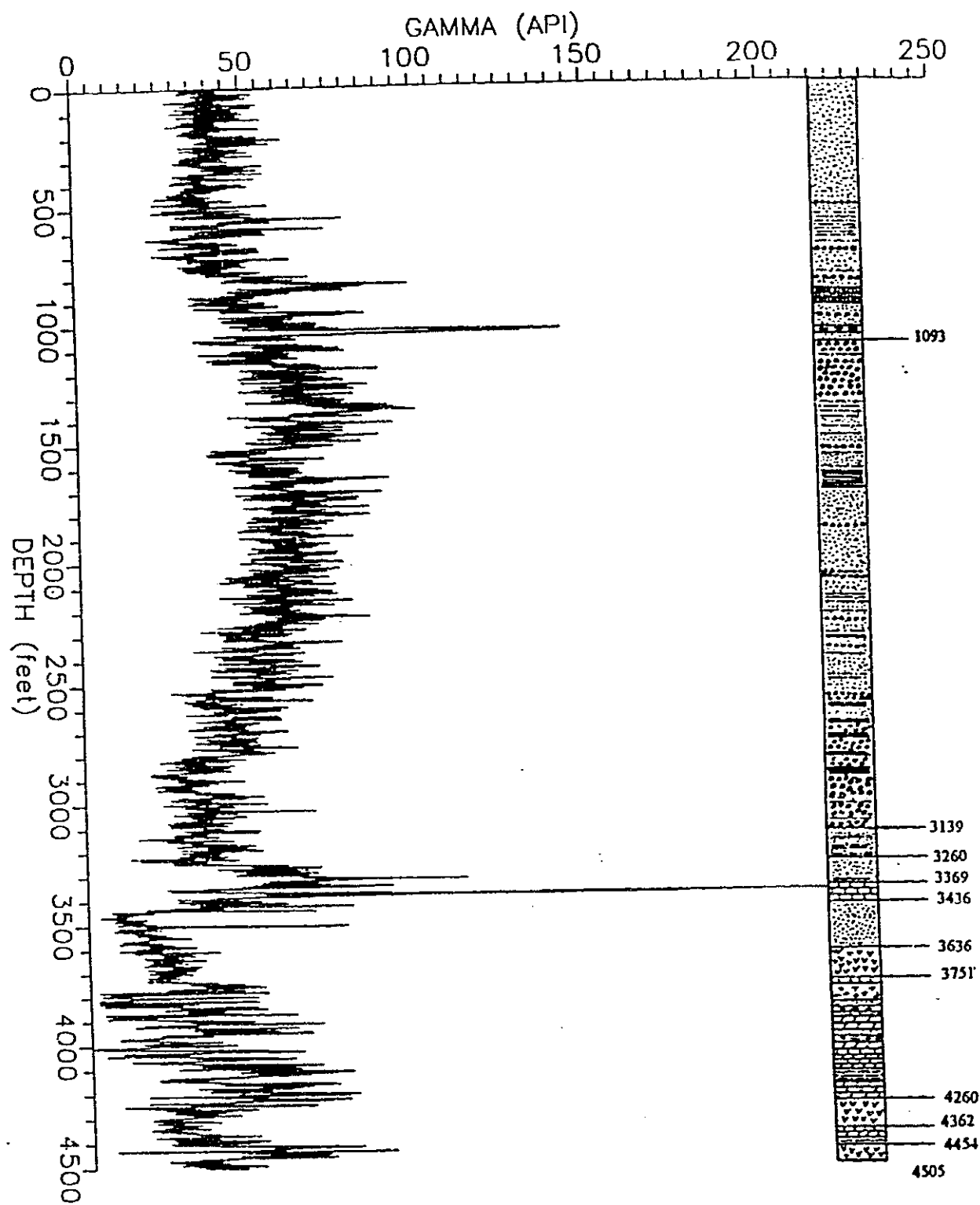


Figure 2. Summary correlation of the natural gamma log and lithology.

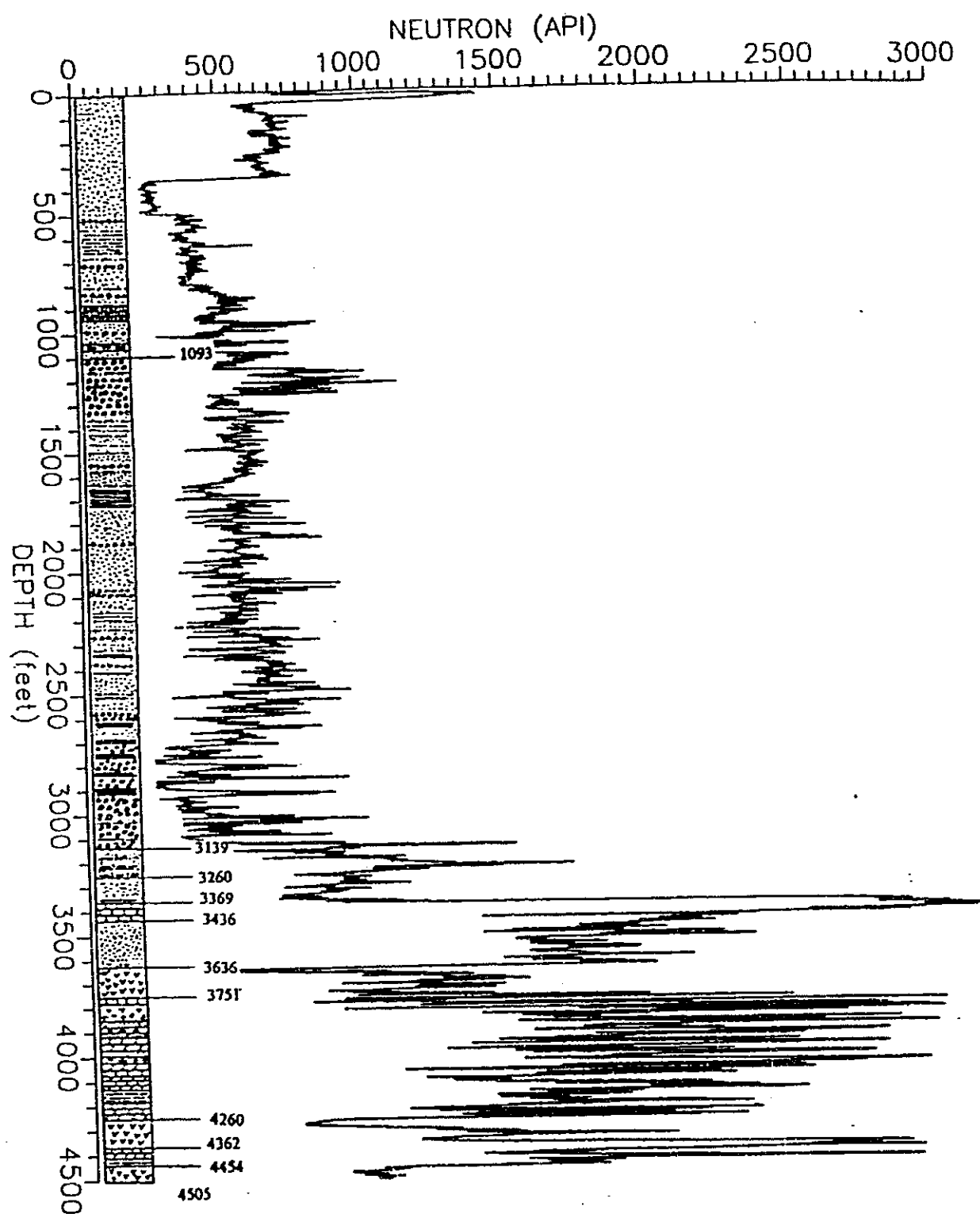


Figure 3. Summary correlation of the neutron log and lithology.

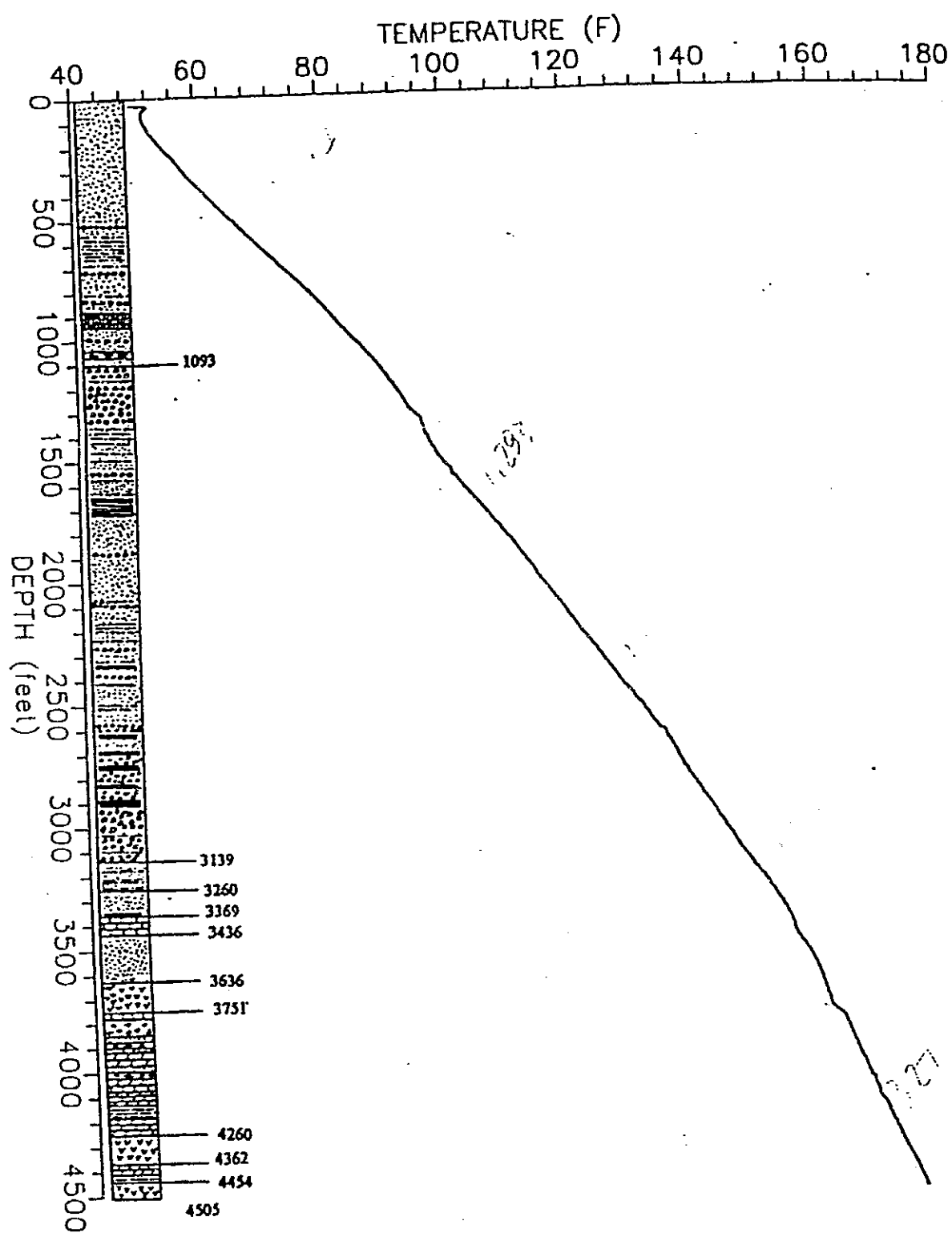


Figure 6. Equilibrium temperature versus depth for the Alpine 1/Federal borehole.



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Geochemical Services for Exploration, Development and Production

Preliminary Report on Geochemical Analysis

Client: Arizona Geological Survey

Operator: New Mexico State University **Driller:** Tonto Drilling Services

Well Name: 1 Alpine-Federal **Location:** 23-6N-30E

County: Apache **State:** Arizona

Ground elevation: 8,556 feet **Depth Interval:** 504 - 4505 (TD) feet

Sample type: Core

Sample Preparation: Samples were washed and ground to pass through a 60 mesh (250 micron) sieve.

Sample Analysis: Samples were analyzed to evaluate their organic richness, petroleum content, petroleum potential, kerogen type, and thermal maturity by total organic carbon (TOC) and Rock-Eval analyses. Random and selected samples were checked to confirm results. Accuracy and reproducibility were checked by analysis of a standard every ten samples.

TOC and Rock-Eval Results Discussion:

The TOC and Rock-Eval data are shown in Table 1. This table shows the depth and age/formation with the analytical results and calculation of various interpretive ratios. A summary of interpretive guidelines for these data is included as Appendix I. Also, shown on these data tables are samples on which analytical results were checked and confirmed as well as the condition of the pyrogram. The pyrogram is a graphic representation of the Rock-Eval S2 peak. If the S2 value is low (< 0.50 mg hydrocarbons/g rock) and the S2 pyrogram is flat, the Rock-Eval Tmax value is not usually accurate due to the difficulty of finding a maximum on a flat peak. A sample having a low S2 value but a distinct S2 peak on the pyrogram has a Tmax value reported. Two samples had low temperature S2 peaks (4325 and 4435 feet). This is probably extractable organic matter (EOM) which is cracked in the S2 peak. If this is correct, the S2 value would be reduced and the S1 value increased. Normal pyrograms have distinct and smooth S2 peaks and always have a Tmax value reported.

The geochemical analysis of core samples from the 1 Alpine-Federal geothermal well in Apache county, Arizona revealed a number of organic rich intervals. A plot of remaining generation potential (Rock-Eval S2) versus TOC (Figure 1) shows numerous intervals with greater than 1.00% TOC. The values plotted as an "x" are samples having less than 1.00% TOC whereas the "o" values have TOC contents greater than 1.00%. The "x" values are insignificant due to their low organic carbon contents and should not be considered indicative of significant petroleum generation potential.



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Geochemical Services for Exploration, Development and Production

Intervals at 3294, 3305 and 3340 feet in the Cretaceous have TOC values of 3.11%, 6.59% and 8.58%, respectively. Likewise, the Permian San Andres limestone reaches 12.77% TOC at 3397 feet and 3.70% at 3410 feet. In the Corduroy formation of the Supai group of Permian age numerous intervals exceed 1.00% TOC including 3878 feet (3.22%), 3975 feet shale and carbonate samples (7.21% and 1.55%, respectively), 4028 feet (3.40%), 4065 feet (1.40%), and from 4125 to 4145 feet (1.86%, 1.65%, and 2.26%). Finally, the Fort Apache member of the Supai group of Permian age reaches 4.25% TOC. This plot is also indicative of the potential of these samples for oil and gas. The Cretaceous intervals are largely gas prone organic matter whereas the Permian aged samples are more oil prone or have mixed oil/gas potential. This is also illustrated by a classical modified van Krevelen plot of hydrogen index ($S2 \times 100/TOC$) versus oxygen index ($S3 \times 100/TOC$) (Figure 2).

A plot of hydrogen index versus Rock-Eval Tmax illustrates the petroleum potential with regard to thermal maturity (Figure 3). The majority of the samples are in the early to mid oil window. Two of the Cretaceous samples analyzed have fairly high Tmax values which would normally be indicative of considerable conversion of organic matter to petroleum products, i.e., peak oil generation. However, the Cretaceous Tmax values appear to be anomalous. This is illustrated in Figure 4 where a depth versus Tmax plot shows their advanced maturity when compared to the Permian rocks at 4000 feet and deeper. The high Tmax values are not supported by the free petroleum content of these samples where the production index (free oil (S1) divided by the sum of the free oil and remaining potential (S2)) are less than 0.05. This is indicative of less than 5% conversion of kerogen to petroleum which is very low for this presumed level of thermal maturity. Tmax is, in fact, a kinetic parameter and is dependent on organic matter composition (kerogen type). However, it is unusual to have such a large offset from the overall trend in the well. These maturity differences need to be examined by utilizing vitrinite reflectance and thermal alteration index analyses. The organic matter type will also be assessed by visual kerogen assessment of the maceral percentages.

In summary, the Cretaceous rocks are organic rich but have hydrogen contents which are indicative of gas generating source rocks. The Rock-Eval Tmax values do not appear to be accurately reflecting advanced maturity based on the low level of conversion of organic matter in these samples. This will be further assessed by completing visual maturity analysis.

The Permian aged rocks are oil prone or have mixed oil and gas potential. Their maturity is early to mid oil window. Their remaining potential to generate liquid petroleum products is high. In areas where they may be more mature they have the capability to generate from 128 to 617 barrels of petroleum per acre-foot based on the potential yields calculated from their present day potential, i.e., Rock-Eval S2 values. Their potential as petroleum source rocks is largely dependent on volumetric considerations and thermal maturity.

Both dead oil and oil shows were reported at the contact of the Tertiary and the Cretaceous, below the San Andres limestone, and 196 feet above the top of the Fort Apache unit in the Corduroy formation (4028 feet). These intervals are being analyzed by thermal extraction/gas chromatography to obtain a fingerprint of the free oil in these rocks. In addition pyrolysis/gas chromatography is also being performed on the organic matter to assess kerogen type.

AGS: #1 ALPINE-FEDERAL

ORGANIC FACIES PLOT

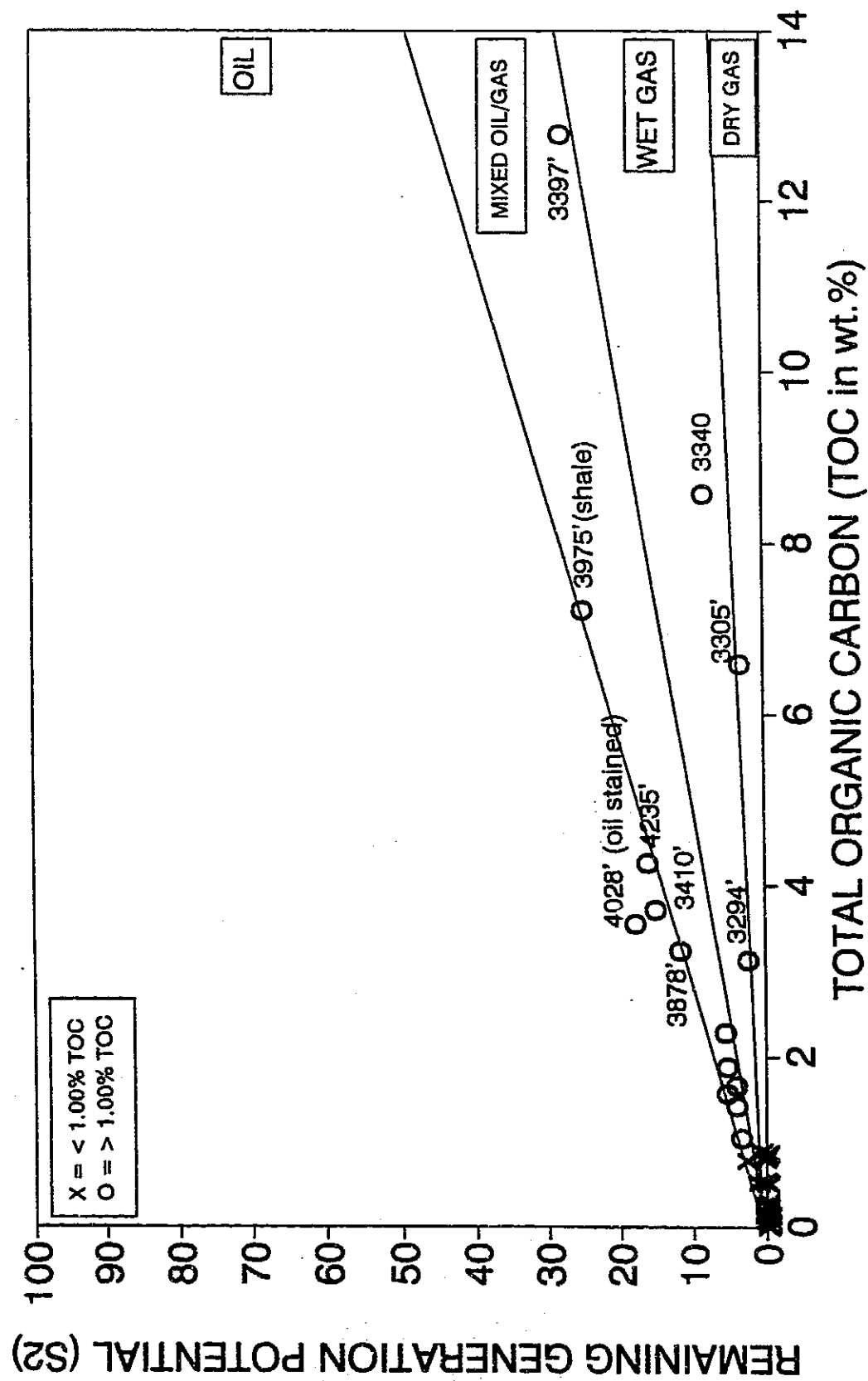
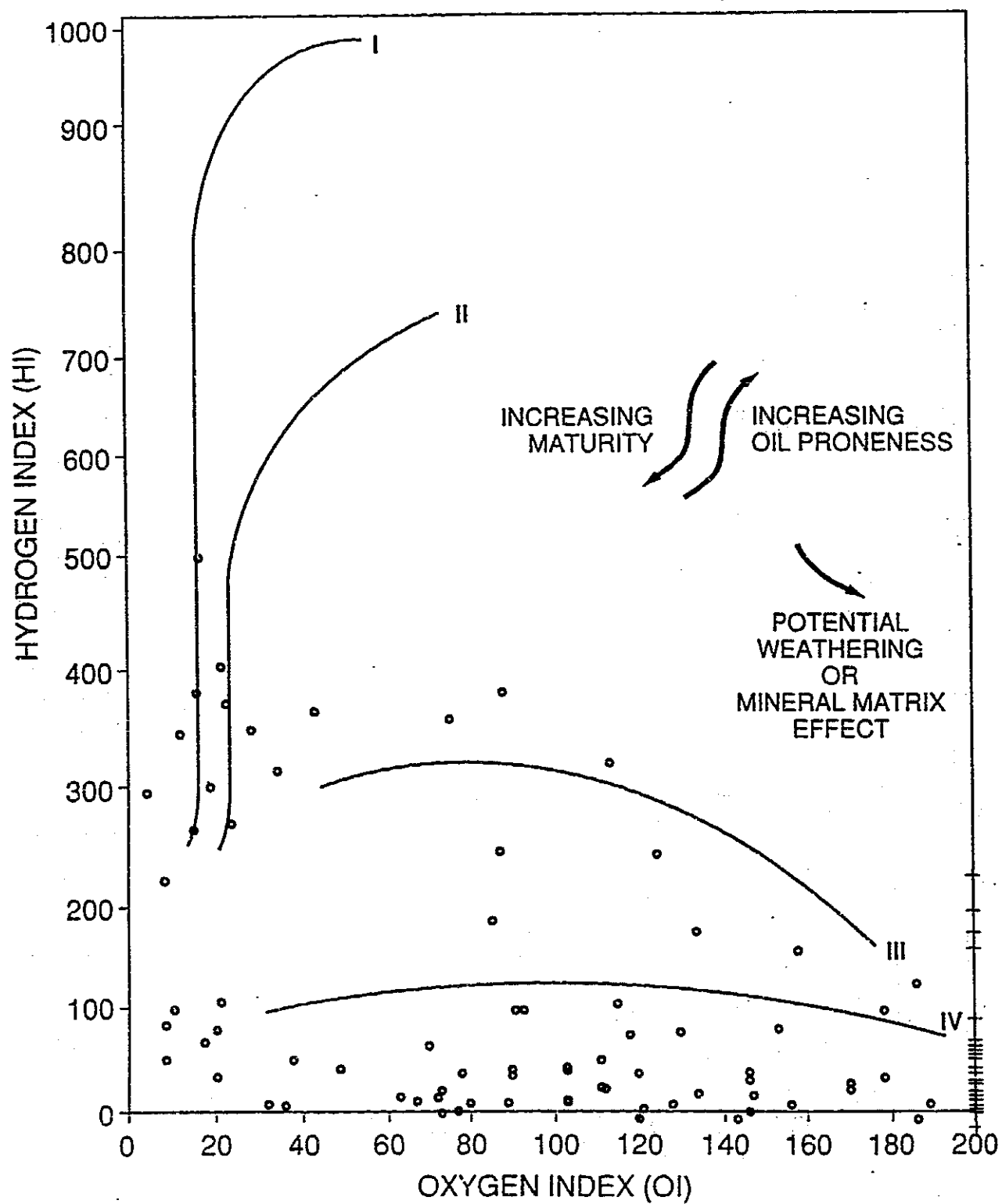
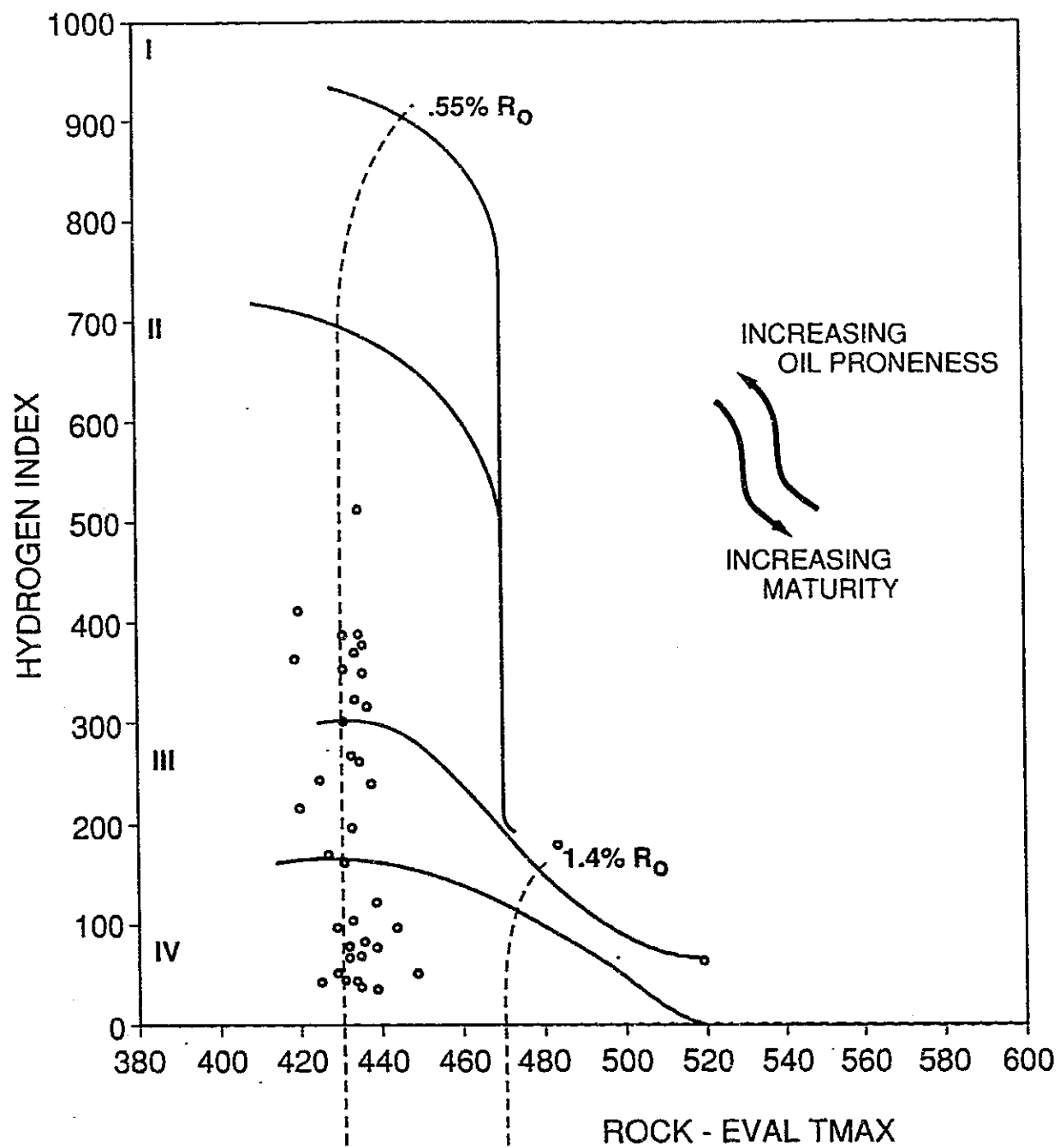


Figure 1

ARIZONA GEOLOGICAL SURVEY
NEW MEXICO STATE UNIVERSITY
#1 ALPINE-FEDERAL
KEROGEN TYPE PLOT



ARIZONA GEOLOGICAL SURVEY
NEW MEXICO STATE UNIVERSITY
#1 ALPINE-FEDERAL
KEROGEN TYPE AND MATURITY PLOT



KEROGEN
TYPE

I	IMMATURE	OIL	GAS
II	IMMATURE	OIL	GAS
III	IMMATURE	OIL	GAS

AGS: #1 ALPINE-FEDERAL DEPTH vs. THERMAL MATURATION

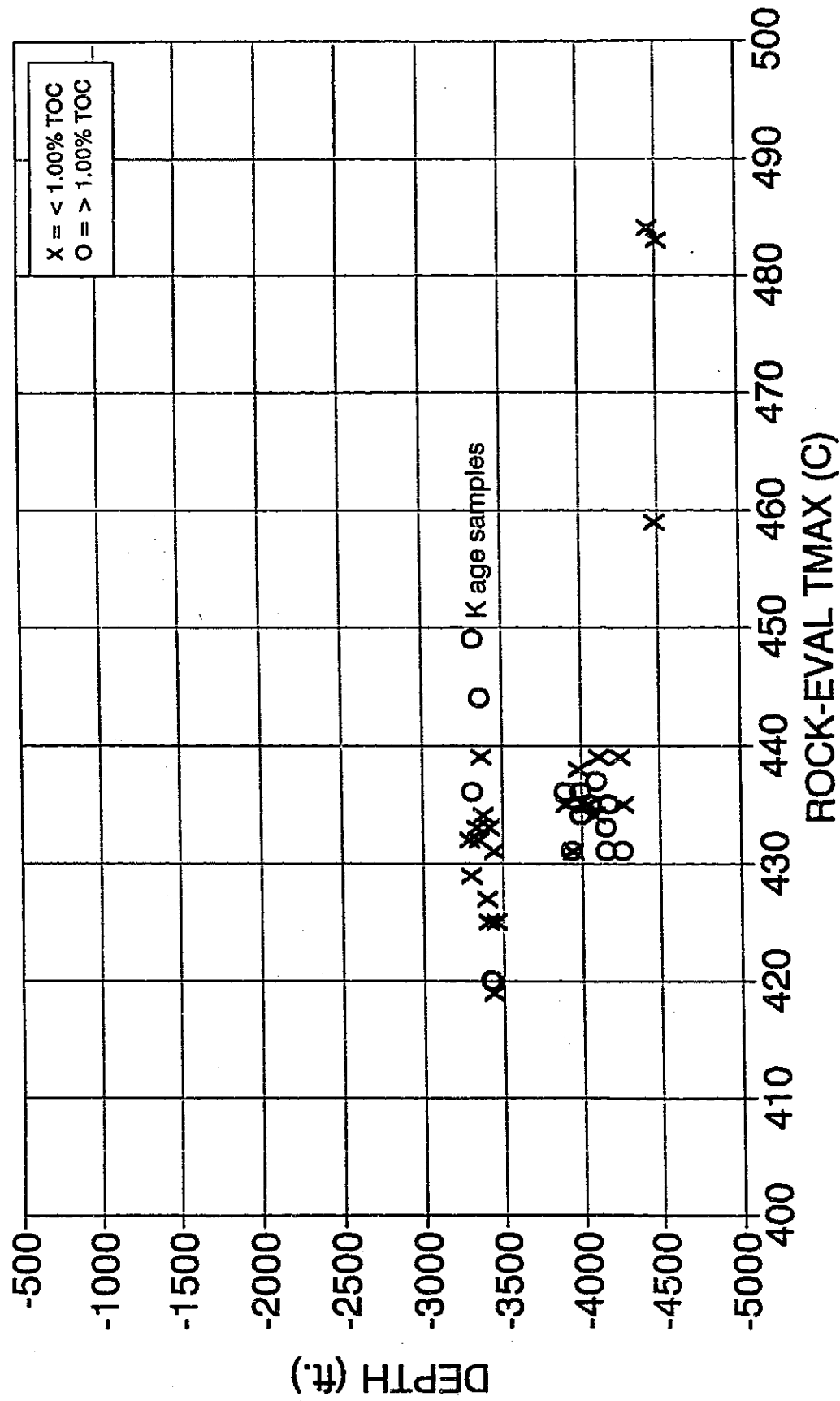


Figure 4

Well ID:1 ALPINE-FED.
Project No:93B-64

Company: N. M. STATE U.
Customer: ARIZONA G.S.

Ana. Date: MAY 10, 1994
File Name: HIS1

DEPTH	TOC		S1	S2	S1+S2	Tmax
	SOURCE QUALITY		PRESENT HYDROCARBONS	POTENTIAL HYDROCARBONS	TOTAL POTENTIAL	ORGANIC MATURATION
	weight %		(mg HC/g rock)	(mg HC/g rock)	(mg HC/g rock)	
	POORGOODEXCL		POORFAIRGOOD	POORFAIRGOOD	POOR FAIR GOOD	OIL
						IM-MATURE
	1.0 2.0		.5 1.0	2.5 5.0	2.0 6.0	GAS
504						435 465
714						
904						
1114						
1314						
1534						
1750						
1953						
2164						
2364						
2560						
2754						
2966						
3255						
3294						
3340						
3380						
3410						
3465						
3585						
3755						
3815						
3865						
3915						
3975						
4015						
4060						
4105						
4145						
4225						
255						
4325						
4385						
4405						
4425						
4455						

HUMBLE GEOCHEMICAL SERVICES: GEOCHEMICAL LOG 2					
Well ID: 1 ALPINE-FED. Project No: 93B-64		Company: N.M. STATE U. Customer: ARIZONA G.S.		Ana. Date: MAY 10, 1994 File Name: HIS1	
DEPTH	HI	OI	S2/S3	PC	PI
	HYDROGEN	OXYGEN	PETROLEUM	PYROLYZED	PRODUCTION
	INDEX	INDEX	TYPE	CARBON	INDEX
	(mg HC/g org.C)	(mg CO2/g org.C)	(mg HC/g rock)	weight %	S1/(S1+S2)
			DRY WET OIL	POOR GOOD EXCEL	SOURCE MIGRATED
	200 600	200 400	2.5 5.0	.3 1.5	0 1
504					
714					
904					
1114					
1314					
1534					
1750					
1953					
2164					
2364					
2560					
2754					
2966					
3255					
3294					
3340					
3380					
3410					
3465					
3585					
3755					
3815					
3865					
3915					
3975					
4015					
4060					
4105					
4145					
4225					
4255					
4325					
4385					
4405					
4425					
4455					

Tonto Drilling Services Alpine-Federal #1
Permit No. 878, Sample No. 1875
NW SW 23-6N-30E
Apache County, Arizona

Ground Elevation 8556'

Core Inventory

Depth	Box#	Depth	Box#	Depth	Box#	Depth	Box#
504-804	S.01	3554-3563	332	3943.5-3951.5	373	4324-4333.5	414
814-1104	S.02	3563-3572.5	333	3951.5-3961	374	4333.5-4343	415
1114-1344	S.03	3572.5-3581	334	3961-3969	375	4343-4353	416
1354-1594	S.04	3581-3591	335	3969-3978	376	4353-4361	417
1604-1848	S.05	3591-3600.5	336	3978-3987	377	4361-4370	418
1859-2134	S.06	3600.5-3610.5	337	3987-3997	378	4370-4379.5	419
2144-2424	S.07	3610.5-3619.5	338	3997-4007	379	4379.5-4388.5	420 Echnoid stem
2434-2734	S.08	3619.5-3629	339	4007-4017	380	4388.5-4398	421
2744-2976	S.09	3629-3638	340	4017-4026.5	381	4398-4408	422
2996-3255	S.10	3638-3647	341	4026.5-4035	382	4408-4418	423
3265.5-3274	302	3647-3656	342	4035-4044.8	383	4418-4428	424
3274-3284	303	3656-3665	343	4044.8-4054.5	384	4428-4438	425
3284-3294	304	3665-3673	344	4054.5-4063.5	385	4438-4445	426
3294-3303.5	305	3673-3682.5	345	4063.5-4072.5	386	4445-4455	427
3303.5-3312	306	3682.5-3691.5	346	4072.5-4082	387	4455-4463.5	428
3312-3321.5	307	3691.5-3701	347	4082-4092	388	4463.5-4473	429
3321.5-3331.2	308	3701-3710.5	348	4092-4101	389	4473-4482	430
3331.2-3340	309	3710.5-3719	349	4101-4110	390	4482-4491	431
3340-3250	310	3719-3728	350	4110-4119.7	391	4491-4501	432
3350-3359.5	311	3728-3737.5	351	4119.7-4129	392	4501-4505	433
HQ 3359.5-3373	312	3737.5-3747	352	4129-4138.7	393		
NQ 3373-3381.5	313	3747-3755.9	353	4138.7-4148	394		
3381.5-3389	314	3755.9-3764.8	354	4148-4156.5	395		
3389-3398.5	315	3764.8-3783	355	4156.5-4166	396		
3398.5-3407	316	3783-3792.5	356	4166-4175	397		
3407-3416	317A	3792.5-3802	357	4175-4184	398		
3416-3425.5	317B	3802-3811.5	358	4184-4193.5	399		
3425.5-3433.5	318	3811.5-3821	359	4193.5-4203	400		
3433.5-3442.5	319	3821-3829.5	360	4203-4212	401		
3442.5-3452	320	3829.5-3839	361	4212-4221.5	402		
3452-3460.5	321	3839-3848	362	4221.5-4231	403		
3460.5-3470	322	3848-3857	363	4231-4241	404		
3470-3479.5	323	3857-3866.5	364	4241-4251	405		
3479.5-3489	324	3866.5-3876	365	4251-4260.5	406		
3489-3498.5	325	3876-3885	366	4260.5-4268	407		
3498.5-3506.5	325	3885-3894.7	367	4268-4277.5	408		
3506.5-3516	327	3894.7-3904.7	368	4277.5-4286.5	409		
3516-3525	328	3904.7-3914.7	369	4286.5-4295.5	410		
3525-3535	329	3914.7-3924	370	4295.5-4305.5	411		
3535-3544.5	330	3924-3933.5	371	4305.5-4315	412		
3544.5-3554	331	3933.5-3943.5	372	4315-4324	413		

core incl
 H Q 3.5" 2.5"
 N Q 2 3/4" 1 7/8"
 B Q 2 7/16" 1 7/16"

NEW MEXICO BUREAU OF MINES CORE NUMBER: 1400

Project: _____ Hole: #1 Alpine Fed.

Donated by: Tonto Drilling Service

Location: County: Apache, Co Arizona

Section: 23 1153/W & 2122/S

Township: 6N Range: 30E

Boxes: 300 (8556) Depth: 502-3255.5

Shelf location: 12(F1)-13(B10)

Remarks: _____

CONSERVATION COMMISSION

OCT 22 1993

Depth	Box#	Depth	Box#	Depth	Box#
502-511.5	1	670-679	19	839.5-848.5	37
511.5-521	2	679-688	20	848.5-858	38
521-530	3	688-697.5	21	858-866.5	39
530-539.5	4	697.5-706.4	22	866.5-876	40
539.5-549	5	706.4-715.9	23	876-885	41
549-559	6	715.9-725.9	24	885-894	42
559-569.7	7	725.9-736	25	894-904	43
569.7-574	8	736-745.5	26	904-913	44
574-584	9	745.5-754	27	914-922	45
584-594	10	754-764	28	924-931.5	46
594-604	11	764-774	29	931.5-936	47
604-614	12	774-784	30	936-944	48
614-624	13	784-793.5	31	944-953	49
624-633	14	793.5-803	32	953-962	50
633-642	15	803-812.5	33	962-971	51
642-652	16	812.5-821.5	34	971-980	52
652-661.5	17	821.5-830	35	980-989	53
661.5-670	18	830-839.5	36	989-998	54

Depth	Box#	Depth	Box#	Depth	Box#
998-1007.5	55	1159-1168.5	73	1324.5-1333	91
1007.5-1017.5	56	1168.5-1177.5	74	1333-1342	92
1017.5-1027.5	57	1177.5-1186.5	75	1342-1351	93
1027.5-1037	58	1186.5-1195.5	76	1351-1360	94
1037-1046	59	1195.5-1205	77	1360-1369.5	95
1046-1055	60	1205-1214	78	1369.5-1378.5	96
1055-1064	61	1214-1223	79	1378.5-1387	97
1064-1069.6	62	1223-1233	80	1387-1396	98
1069.6-1075	63	1233-1243	81	1396-1405	99
1075-1084	64	1243-1253	82	1405-1413.5	100
1084-1094	65	1253-1263	83	1413.5-1422	101
1094-1103	66	1263-1273	84	1422-1431	102
1103-1113	67	1273-1282	85	1431-1439	103
1113-1121	68	1282-1291	86	1439-1449	104
1122-1131	69	1291-1300	87	1449-1459	105
1131-1140	70	1300-1309	88	1459-1469	106
1140-1150	71	1309-1316	89	1469-1479	107
1150-1159	72	1316-1324.5	90	1479-1489	108

(ALPINE CONT.)

CONSERVATION DIVISION
OCT 22 1993

Depth	Box#	Depth	Box#	Depth	Box#
1975-1984	163	2143-2152	181	2307.5-2316	199
1984-1994	164	2152-2161	182	2316-2325	200
1994-2003	165	2161-2170	183	2325-2334.5	201
2003-2012.5	166	2170-2179.5	184	2334.5-2343.5	202
2012.5-2021.5	167	2179.5-2188	185	2343.5-2353	203
2021.5-2031	168	2188-2197.5	186	2353-2362	204
2031-2041	169	2197.5-2206.5	187	2362-2371	205
2041-2049.5	170	2206.5-2215.5	188	2371-2380	206
2049.5-2058.5	171	2215.5-2224	189	2380-2389	207
2058.5-2068	172	2224-2234	190	2389-2399	208
2068-2077	173	2234-2243	191	2399-2409	209
2077-2086	174	2243-2252	192	2409-2418.5	210
2086-2096	175	2252-2261	193	2418.5-2427	211
2096-2105	176	2261-2270	194	2427-2436	212
2105-2115	177	2270-2279	195	2436-2445.5	213
2115-2124	178	2279-2289	196	2445.5-2454	214
2124-2133	179	2289-2298	197	2454-2463.5	215
2133-2143	180	2298-2307.5	198	2463.5-2472	216

(ALPINE CONT.)

Depth	Box#	Depth	Box#	Depth	Box#
1489-1499	109	1648-1658	127	1810-1820	145
1499-1506	110	1658-1667	128	1820-1829	146
1506-1514.5	111	1667-1675.5	129	1829-1838	147
1514.5-1523.5	112	1675.5-1684.8	130	1838-1847	148
1523.5-1532	113	1684.8-1694	131	1847-1856	149
1532-1542	114	1694-1702.5	132	1856-1865	150
1542-1550.5	115	1702.5-1711.5	133	1865-1875	151
1550.5-1559	116	1711.5-1720.5	134	1875-1884	152
1559-1568	117	1720.5-1730	135	1884-1893	153
1568-1577	118	1730-1737	136	1893-1902	154
1577-1586.5	119	1737-1746.5	137	1902-1911	155
1586.5-1595.5	120	1746.5-1755.5	138	1911-1920	156
1595.5-1604	121	1755.5-1764.5	139	1920-1928.5	157
1604-1612.5	122	1764.5-1773.5	140	1928.5-1938	158
1612.5-1621.5	123	1773.5-1782.5	141	1938-1947	159
1621.5-1630	124	1782.5-1791	142	1947-1957	160
1630-1639	125	1791-1800	143	1957-1966	161
1639-1648	126	1800-1810	144	1966-1975	162

Depth	Box#	Depth	Box#	Depth	Box#
2472-2481.5	217	2637-2647	235	2807-2816	253
2481.5-2490.5	218	2647-2656.5	236	2816-2825	254
2490.5-2499.5	219	2656.5-2665	237	2825-2834	255
2499.5-2509.5	220	2665-2674	238	2834-2843	256
2509.5-2520	221	2674-2682.5	239	2843-2853	257
2520-2529.5	222	2682.5-2692.5	240	2853-2862	258
2529.5-2539	223	2692.5-2701	241	2862-2871	259
2539-2548	224	2701-2711	242	2871-2881	260
2548-2556.5	225	2711-2720	243	2881-2890	261
2556.5-2565.5	226	2720-2729	244	2890-2899.5	262
2565.5-2574.5	227	2729-2738	245	2899.5-2909	263
2574.5-2583.5	228	2738-2748	246	2909-2918	264
2583.5-2592	229	2747-2756	247	2918-2926	265
2592-2601	230	2756-2765	248	2926-2938.5	266
2601-2610	231	2765-2774.5	249	2938.5-2948	267
2610-2619	232	2774.5-2786	250	2948-2957	268
2619-2628	233	2786-2797	251	2957-2966	269
2628-2637	234	2797-2807	252	2966-2975.5	270

CONSERV

OCT 22 1993

Depth	Box#	Depth	Box#
2975.5-2984	271	3147-3156	289
2984-2993	272	3156-3164.5	290
2993-3002	273	3164.5-3172.5	291
3002-3011	274	3172.5-3182	292
3011-3020	275	3182-3191	293
3020-3028.5	276	3191-3200	294
3028.5-3039	277	3200-3209.5	295
3039-3048	278	3209.5-3218.5	296
3048-3056.5	279	3218.5-3228	297
3056.5-3066	280	3228-3236.5	298
3066-3075	281	3236.5-3246	299
3075-3084	282	3246-3255.5	300
3084-3098	283		
3098-3107.5	284		
3107.5-3117.5	285		
3117.5-3127.4	286		
3127.4-3137.4	287		
3137.4-3147	288		

(ALPINE CONT.)

ALPINE MOUNTAIN
CONSERVATION COMMISSION

OCT 22 1993

III. BOXING AND LABELING THE CORE.

A. Labeling core boxes

file 878

Cardboard boxes, supplied by the driller, will be used to store core. Both ends of the core boxes should be labeled. Minimum labeling should include:

- Well name (TONTTO/ALPINE #1)
- Core run number.
- Beginning footage and ending footage.

B. Placing core in the core boxes.

The core will be boxed so that the top of the run is in the upper left corner. Figure 3 shows an example core placement in a core box.

- A run block (a wooden block wrapped with yellow or orange flagging) is placed in the core box in the upper left corner. The first piece of core from an individual run is placed behind the run block. The run block is labelled with a permanent marker (indelible ink) as follows:

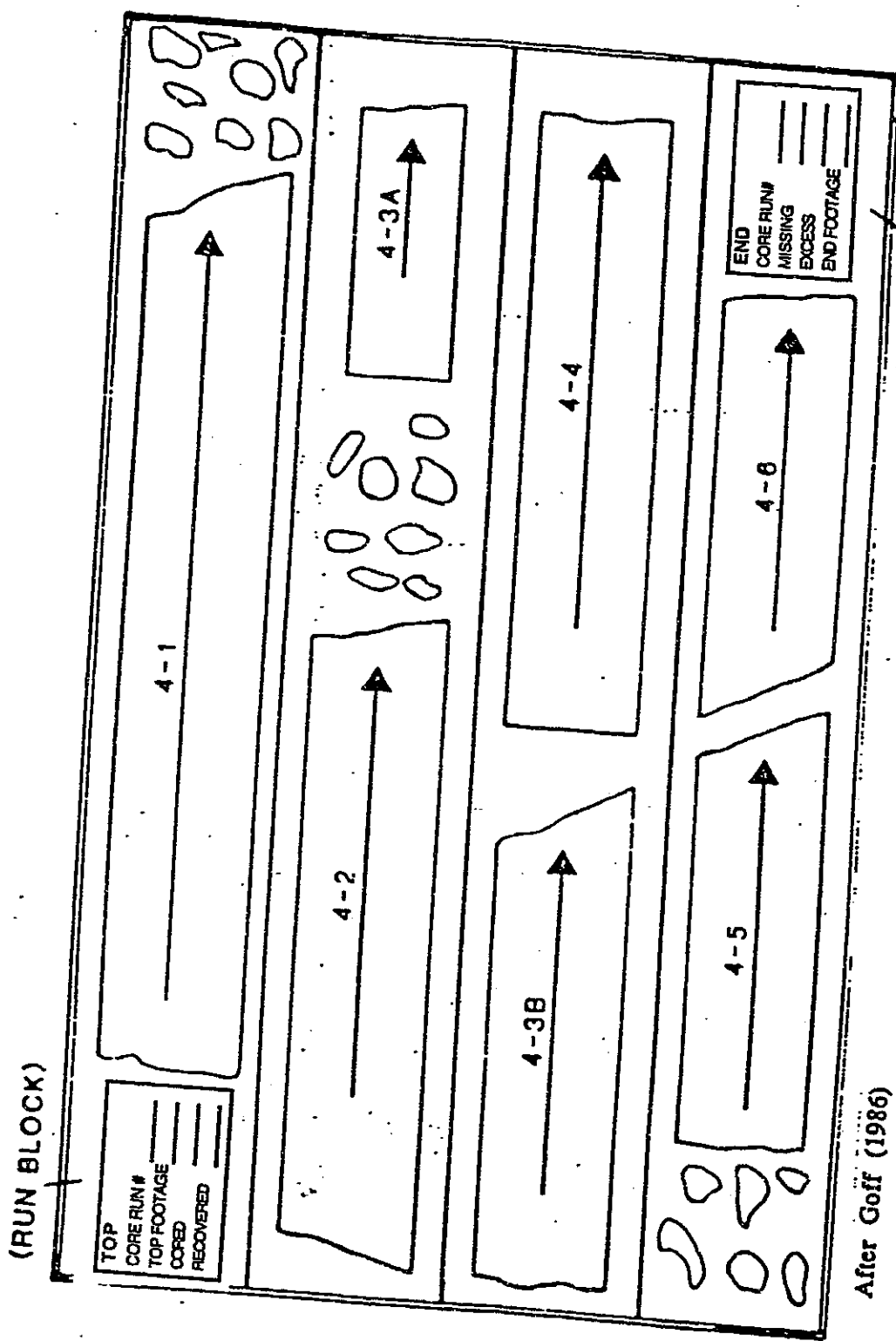
- | | | |
|-------|----|-------------------------------------|
| Front | 1. | Well name (TONTTO/ALPINE #1). |
| Back | 2. | Core run number, followed by "TOP". |
| | 3. | Interval cored. |
| | 4. | Amount cored. |
| | 5. | Amount recovered. |

- It may be necessary to break core for boxing or sampling. The break should be marked and the pieces renumbered with alphabetical designations (Figure 4).

1. Break the core with a hammer.
2. Relabel core pieces with alphabetical designations ("A" for the top piece).
3. Fit the two pieces of broken core back together.
4. Place three (3) diagonal parallel lines across the break with a grease pencil or felt tip permanent marker.

- An end block will follow the last piece of core in the box. The end block is labeled with a permanent marker as follows.

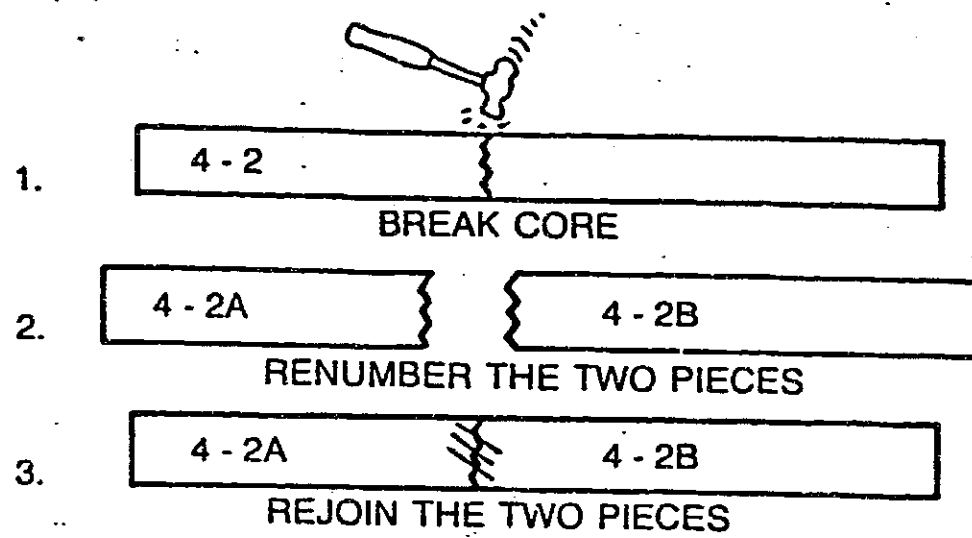
- | | | |
|-------|----|-------------------------------------|
| Front | 1. | Core run number, followed by "END". |
| | 2. | Missing core (Label with "M"). |
| | 3. | Excess core (Label with "E"). |
| | 4. | Ending footage. |
| Side | 5. | Ending footage. |



After Goff (1986)

BLOCK INDICATING
RUN #, AMOUNT LOST
ENDING FOOTAGE

Figure 3 Core box arrangement.



After Goff (1986)

Figure 4 Procedure for breaking and marking broken core.

SUNDRY NOTICES AND REPORTS ON WELLS
GEOTHERMAL RESOURCES

1. NAME OF OPERATOR Tonto Drilling Services, Inc
2. GEOTHERMAL RESOURCES WELL ☐ OTHER ☒ (Specify) slim-hole/temperature observation
3. WELL NAME Tonto/Alpine #1/Federal
LOCATION Alpine Divide 1152.96 FWL 2122.34 FSL
SEC. 23 TWP. T6N RGE. R30E COUNTY Apache ARIZONA.
4. FEDERAL, STATE OR INDIAN LEASE NUMBER, OR LESSOR'S NAME IF FEE LEASE.
Apache/Sitgreaves National Forest
5. FIELD OR POOL NAME. wildcat
6. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE, REPORT OR OTHER DATA

NOTICE OF INTENTION TO:

SUBSEQUENT REPORT OF:

TEST WATER SHUT-OFF	<input type="checkbox"/>	PULL OR ALTER CASING	<input type="checkbox"/>	WATER SHUT-OFF	<input type="checkbox"/>	MONTHLY PROGRESS	<input type="checkbox"/>
FRACTURE TREAT	<input type="checkbox"/>	DIRECTIONAL DRILL	<input type="checkbox"/>	FRACTURE TREATMENT	<input type="checkbox"/>	REPAIRING WELL	<input type="checkbox"/>
SHOOT OR ACIDIZE	<input type="checkbox"/>	PERFORATE CASING	<input type="checkbox"/>	SHOOTING OR ACIDIZING	<input type="checkbox"/>	ALTERING CASING	<input checked="" type="checkbox"/>
REPAIR WELL	<input type="checkbox"/>	CHANGE PLANS	<input type="checkbox"/>	(OTHER)	<input type="checkbox"/>	ABANDONMENT	<input type="checkbox"/>
(OTHER)	<input type="checkbox"/>						

7. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work. If well is directionally drilled, give subsurface locations and measured and true vertical depths for all markers and zones pertinent to this work.)

See Attached Description

AZ OIL & GAS
CONSERVATION COMMISSION

OCT 1 1993

8. I hereby certify that the foregoing is true and correct.

Signed

Title Vice Pres./Gen.Mgr Date 9-30-93

Permit No. 878

STATE OF ARIZONA
OIL & GAS CONSERVATION COMMISSION
Sundry Notices and Reports On Wells
File Two Copies
Form No. 6-12

BRIEF WELL HISTORY

- 8/1/93 Coring from 2966 to 3016 feet (0000-2400 hrs).
- 8/2/93 Coring from 3016 to 3054 feet (0000-2130 hrs). Change-out old mud, mix new mud (1100-1255 hrs). Trip-out, change bit (2130-2400 hrs).
- 8/3/93 Bit change continues, trip-in, chase cave at 3046 to 3054 feet, 1.5 feet cave recovered (0000-0030 hrs). Coring from 3054 to 3096 feet (0358-2400 hrs).
- 8/4/93 Coring from 3096 to 3155 feet (0000-2400 hrs). Clean drill cuttings from mud pits with backhoe (1030-1130 hrs).
- 8/5/93 Coring from 3155 to 3207 feet (0000-1839 hrs). No core retrieval on run 275, replace overshot (1740-1810 hrs), condition hole (1815-1828 hrs), retry to retrieve core tube (1828-1839 hrs), stuck tube (bent drill rod obstruction). Trip-out to retrieve tube and core, change bit and reamer shell (1921-2400 hrs), dented and bent rod replaced at 2980 to 2990 feet, probable cave (rods sticking while pulling out of hole (2800 to 3010 feet).
- 8/6/93 Trip-in, chase cave to bottom (0000-1235 hrs). Replace core catcher (1235-1320 hrs). Coring from 3207 to 3236 feet (1320-2400 hrs). Rods torque-up three times while coring run 276 from 3216 to 3236 feet (1838-2400 hrs).
- 8/7/93 Coring from 3236 to 3308 feet (0000-2400 hrs).
- 8/8/93 Coring from 3308 to 3337 feet (0000-1350 hrs). Pull-back rods 480 feet, condition hole, ream hole and chase cave back to bottom (1350-2400 hrs). Encountered cave bridges at 3020 feet and from 3036 to 3039 feet.
- 8/9/93 Continue conditioning hole, reaming and chasing cave, 3 feet of cave recovered (0000-0320 hrs). Mix new mud, change-out old mud (1100-1430 hrs). Reaming back to bottom (1430-1820 hrs). Coring from 3337 to 3338 feet (1915-2145 hrs).
- 8/10/93 Coring from 3338 to 3352 feet (0000-2400 hrs). *CHANGE DRILL PLAN/REDUCE TO NQ*
- 8/11/93 Coring from 3352 to 3369 feet (0000-7333 hrs). Differential stuck at 3369 feet (0733 hrs). Circulate detergent, try to work rods free (0800-2400 hrs).
- 8/12/93 Continue differential stuck at 3369 feet, circulate detergent, try to work rods free (0000-1900 hrs). Nipple-down BOP, prepare to cement for reduction from HQ to NQ (0700-1900 hrs). Run cement, HQ bit 10 feet from bottom at 3360 feet (1930-2210 hrs). WOC (2210-2400 hrs).
- 8/13/93 WOC, prepare NQ string, nipple-up and test BOP (0000-1200 hrs). Trip-in NQ rods (0700-1200 hrs), tag cement at 3294 feet, drill-out cement (1335-2400 hrs).
- 8/14/93 Continue to drill-out cement to 3345 feet, no cement below HQ core-barrel landing ring, stuck NQ tube (0000-0122 hrs). Perform rig maintenance, change out mud, and haul water (0122-0350 hrs). Trip-out, and haul water (0350-0720 hrs). Free-up stuck tube and makeup wash rod (0720-0930 hrs). Trip-in wash rod (0930-1200 hrs). Wash and clean hole and prepare to cement (1200-1900 hrs). Run cement (1900-2130 hrs). WOC, trip-out (2130-2400 hrs).

CONSERVATION COMMISSION

OCT 1 1993

8/15/93 WOC, trip-in and wash-down hole (0000-0400 hrs). Tag cement at 3200 feet, core cement (0400-1230 hrs). Mix new mud, change-out old mud (1415-1600 hrs). Coring from 3369 to 3399 feet (1230-2400 hrs).

8/16/93 Coring from 3399 to 3475 feet (0000-2400 hrs). Lost circulation from 3415 to 3475 feet, major open fractures in core at 3459 and 3462 feet. Lost circulation material (LCM) slugs at 3415 feet (0400-0430 hrs), at 3439 feet (1030-1135 hrs), and at 3349 feet (1540-1710 hrs).

8/17/93 Coring from 3475 to 3515 feet (0800-2400 hrs). Condition hole and send LCM slug at 3475 feet (0000-0800 hrs). Condition hole and send LCM slug at 3515 feet (2100-2345 hrs).

8/18/93 Coring from 3515 to 3585 feet (0000-2400 hrs). Condition hole and send LCM slug at 3535 feet (0400-0930 hrs).

8/19/93 Coring from 3585 to 3655 feet (0000-2400 hrs). Partial returns from 3635 to 3655 feet.

8/20/93 Coring from 3655 to 3725 feet (0000-2400 hrs). Partial returns from 3655 to 3685 feet. Pull-back rods 440 feet at 3725 feet to condition hole and flush LCM and mud rings from drill string (2200-2400 hrs).

8/21/93 Continue to condition hole and ream to bottom (0000-0121 hrs). Coring from 3725 to 3775 feet (0121-1425 hrs). Differential stuck, circulate detergent and work rods free at 3765 feet (1425-1510 hrs). Core barrel mislatch on run 328 from 3765 to 3775 feet, lost core (1510-1740 hrs). Trip-out from 3775 feet (1820-2400 hrs).

8/22/93 Coring from 3775 to 3855 feet (0000-2400 hrs). Lost circulation from 3815 to 3835 feet (1600-2112 hrs). Condition hole, send LCM slugs at 3185 feet (1445-1537 hrs), and at 3835 feet (1940-2112 hrs). Perform maintenance on rig hydraulics at 3805 feet (1225-1307 hrs).

8/23/93 Coring from 3855 to 3975 feet (0000-2400 hrs).

8/24/93 Coring from 3975 to 4085 feet (0000-2400 hrs).

8/25/93 Coring from 4085 to 4195 feet (0000-2400 hrs). Condition hole, circulate LCM slug at 4135 feet (1045-1145 hrs) and at 4145 feet (1400-1525 hrs).

8/26/93 Coring from 4195 to 4284 feet (0000-2400 hrs).

8/27/93 Coring from 4284 to 4375 feet (0000-2400 hrs). Rig maintenance at 4355 feet (1740-1800 hrs).

8/28/93 Coring from 4375 to 4475 feet (0000-2400 hrs).

8/29/93 Coring from 4475 to 4505 feet, total depth (TD) at 4505 feet (0000-0634 hrs). Rig maintenance (0652-0800 hrs). Wiper-run then trip-out from 4505 feet (0830-1300 hrs). Nipple-down BOP (1300-1330 hrs). Test and trip-in cutter, make first cut at 2700 feet on HQ rods (1345-1900 hrs). Pull-out of hole, rebuild cutter, trip-back, try two more cuts, pull-out, trip-back with new cutter (1900-2400 hrs).

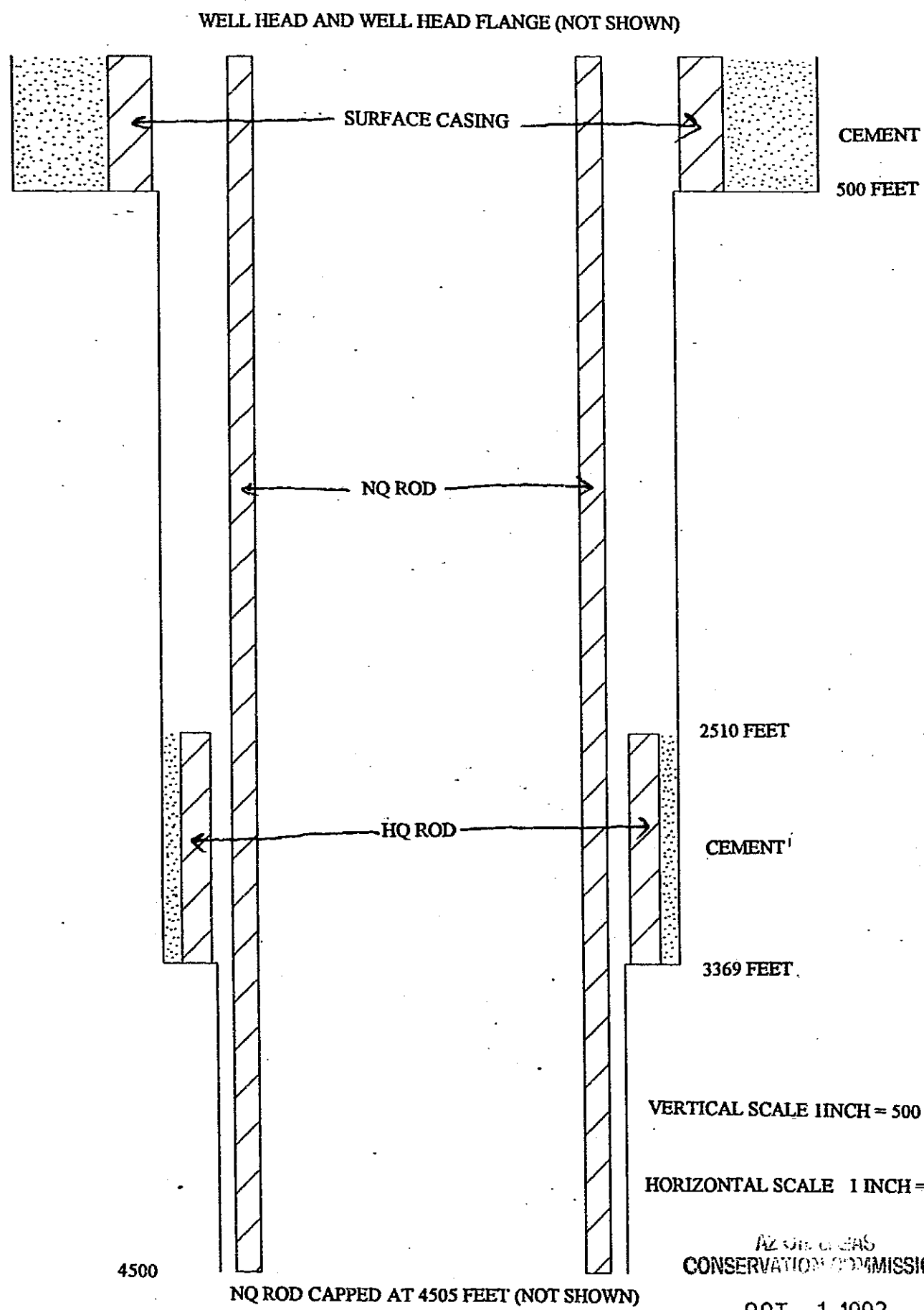
CHANGE FROM 1 1/2 INCH LINEA TO NQ ROD
COMPLETION
AND PULL
UNCEMENTED
HQ ROD

8/30/93 Successful cut at 2510 feet, pull 251 HQ rods, 85 HQ rods left in hole (0000-2400 hrs). Jim Witcher leaves Alpine with load of core for the AZGS depository in Tucson.

8/31/93 Trip-in 4505 feet of greased-up NQ rods, capped at bottom and filled with clean water (0000-0700 hrs). Nipple-up well head, begin rigging-down and demobilization, temperature log bore hole through the NQ rods (0700-1900 hrs). Witcher delivers core to AZGS in Tucson.

CONSERVATION COMMISSION

OCT 1 1993



MEMORANDUM TO FILE

DATE: July 13, 1993

FROM: Steven L. Rauzi *SLR*
Oil and Gas Program Administrator

SUBJECT: Cement surface casing and test BOPE and casing
TONTA DRILLING SERVICES, ALPINE-FEDERAL #1, STATE PERMIT 878

On Saturday, July 10, 1993, I witnessed the running and cementing of the 4 1/2 inch surface casing on the referenced well. The casing was run to 500 feet with a centralizer every 100 feet. About 300 gallons of cement were pumped and displaced with about 310 gallons of mud and wash water. About 15 to 20 gallons of cement circulated when the top cementing plug bumped the float collar, which was about 20 feet off bottom. Wait on cement for 24 hours.

On Sunday, July 11, 1993, I witnessed the pressure test of the blow-out prevention equipment. The blind and pipe rams were each tested to 1000 psi for 15 minutes and held pressure. The annular preventer was tested but would not hold pressure because of a bad pipe joint. The bad pipe joint was replaced with a spool, and the annular preventer was successfully tested to 1000 psi for 15 minutes. All tests of the BOPE were open to the casing resulting in a successful casing test to 1000 psi for 30 minutes.



PERMIT TO DRILL

This constitutes the permission and authority from the
OIL AND GAS CONSERVATION COMMISSION,
STATE OF ARIZONA,

To: TONTO DRILLING SERVICES, INC.
(OPERATOR)

to drill a well to be known as

#1 ALPINE-FEDERAL
(WELL NAME)

located 1152.96 feet from west line and 2122.34 feet from south line

Section 23 Township 6 N Range 30 E, APACHE County, Arizona.

The NOT APPLICABLE STRATIGRAPHIC TEST of said
Section, Township and Range is dedicated to this well.

Said well is to be drilled substantially as outlined in the attached Application and must be drilled
in full compliance with all applicable laws, statutes, rules and regulations of the State of Arizona.

Issued this 18 day of MAY, 1993.

OIL AND GAS CONSERVATION COMMISSION

By Steven L. Raming
EXECUTIVE DIRECTOR
OIL & GAS PROGRAM ADMINISTRATION

PERMIT 00878

RECEIPT NO. 3040

A.P.I. NO. 02-001-90012

State of Arizona
Oil & Gas Conservation Commission
Permit to Drill

FORM NO. 27

APPLICATION FOR PERMIT TO DRILL OR RE-ENTER GEOTHERMAL RESOURCES WELL			
APPLICATION TO DRILL <input checked="" type="checkbox"/>		RE-ENTER OLD WELL <input type="checkbox"/>	
NAME OF COMPANY OR OPERATOR Tonto Drilling Services, Inc.			
ADDRESS 2200 South 4000 West		CITY Salt Lake City STATE Utah	
84120			
DRILLING CONTRACTOR Tonto Drilling Services, Inc.			
ADDRESS same as above			
DESCRIPTION OF WELL AND LEASE			
FEDERAL, STATE OR INDIAN LEASE NUMBER, OR IF FEE LEASE, NAME OF LESSOR Apache-Sitgreaves National Forest		WELL NUMBER Tonto/Alpinel/Federal ELEVATION (GROUND) see attached survey plat	
NEAREST DISTANCE FROM PROPOSED LOCATION TO PROPERTY OR LEASE LINE: N/A FEET		DISTANCE FROM PROPOSED LOCATION TO NEAREST DRILLING, COMPLETED OR APPLIED-FOR WELL ON THE SAME LEASE: N/A FEET	
NUMBER OF ACRES IN LEASE: N/A		NUMBER OF WELLS ON LEASE, INCLUDING THIS WELL, COMPLETED IN OR DRILLING TO THIS RESERVOIR: N/A	
IF LEASE, PURCHASED WITH ONE OR MORE WELLS DRILLED, FROM WHOM PURCHASED: NAME ADDRESS N/A			
WELL LOCATION (GIVE FOOTAGE FROM SECTION LINES) 1152.96' FWL & 2122.34' FSL see attached survey plat		SECTION-TOWNSHIP-RANGE OR BLOCK AND SURVEY DEDICATION (COMPLY WITH RULE G-105) sec 23, T6N, R30E 40 acres	
FIELD AND RESERVOIR (IF WILDCAT, SO STATE) wildcat		COUNTY Apache County	
DISTANCE, IN MILES, AND DIRECTION FROM NEAREST TOWN OR POST OFFICE 6 miles north of Alpine, Arizona			
PROPOSED DEPTH: 4,500 feet		ROTARY OR CABLE TOOLS rotary wireline-core	
BOND STATUS AMOUNT \$5,000		APPROX. DATE WORK WILL START 1 June 1993	
ORGANIZATION REPORT ON FILE OR ATTACHED <input checked="" type="checkbox"/>		FILING FEE OF \$25.00 ATTACHED <input checked="" type="checkbox"/>	
REMARKS: API # 02-001-90012			
Vice President/ General Manager			
CERTIFICATE: I, THE UNDERSIGNED, UNDER THE PENALTY OF PERJURY, STATE THAT I AM THE OF THE Tonto Drilling Ser. Inc. (COMPANY), AND THAT I AM AUTHORIZED BY SAID COMPANY TO MAKE THIS REPORT; AND THAT THIS REPORT WAS PREPARED UNDER MY SUPERVISION AND DIRECTION AND THAT THE FACTS STATED THEREIN ARE TRUE, CORRECT AND COMPLETE TO THE BEST OF MY KNOWLEDGE.			
SIGNATURE George A. McLaren DATE April 30, 1993			
PERMIT NUMBER: 878 APPROVAL DATE: 5-18-93 APPROVED BY: Sherrill R. Ranz NOTICE: BEFORE SENDING IN THIS FORM BE SURE THAT YOU HAVE GIVEN ALL INFORMATION REQUESTED. MUCH UNNECESSARY CORRESPONDENCE WILL THUS BE AVOIDED.		STATE OF ARIZONA OIL & GAS CONSERVATION COMMISSION APPLICATION TO DRILL OR RE-ENTER FILE TWO COPIES FORM NO. G-3	

(COMPLETE REVERSE SIDE)

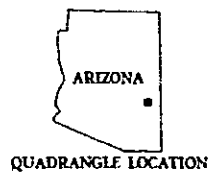
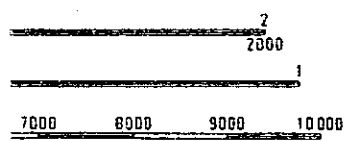
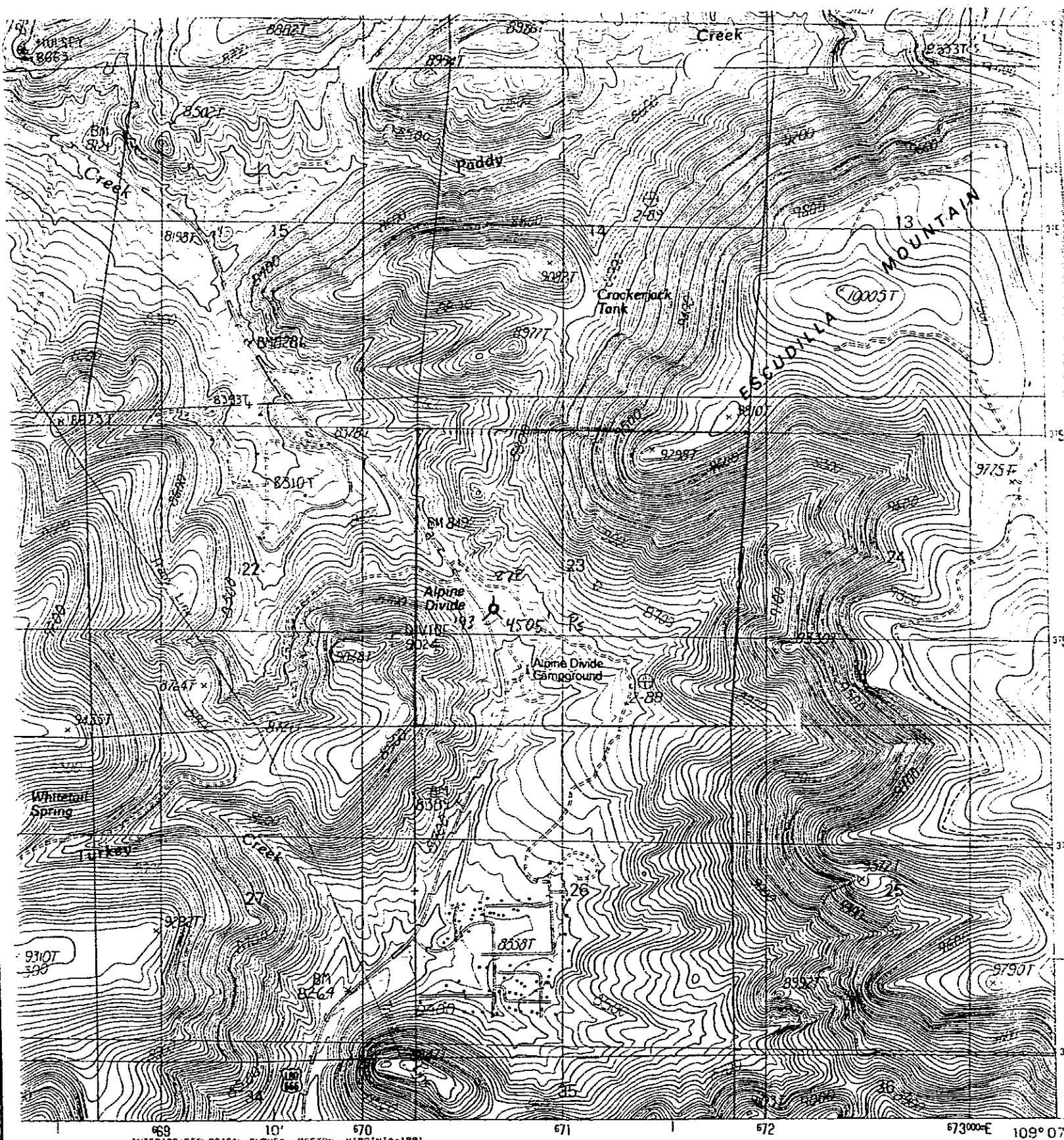
1. OPERATOR SHALL OUTLINE THE DEDICATED ACREAGE FOR GEOTHERMAL RESOURCES WELLS ON THE PLAT.
2. A REGISTERED PROFESSIONAL ENGINEER OR LAND SURVEYOR REGISTERED IN THE STATE OF ARIZONA OR APPROVED BY THE COMMISSION SHALL SHOW ON THE PLAT THE LOCATION OF THE WELL AND CERTIFY THIS INFORMATION IN THE SPACE PROVIDED.
3. ALL DISTANCES SHOWN ON THE PLAT MUST BE FROM THE OUTER BOUNDARIES OF THE SECTION.
4. IS THE OPERATOR THE ONLY OWNER IN THE DEDICATED ACREAGE OUTLINED ON THE PLAT BELOW? YES _____ NO X
5. IF THE ANSWER TO QUESTION FOUR IS "NO" HAVE THE INTERESTS OF ALL THE OWNERS BEEN CONSOLIDATED BY COMMUNITIZATION AGREEMENT OR OTHERWISE? YES _____ NO X. IF ANSWER IS "YES" TYPE OF CONSOLIDATION _____
6. IF THE ANSWER TO QUESTION FOUR IS "NO", LIST ALL THE OWNERS AND THEIR RESPECTIVE INTERESTS BELOW:

Apache Sitgreaves National Forest - Surface / USBLM - Geothermal

Owner	Land Description												
<div style="display: flex; justify-content: space-between;"> <div style="width: 55%;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%; height: 100px;"></td> <td style="width: 25%;"></td> <td style="width: 25%;"></td> <td style="width: 25%;"></td> </tr> <tr> <td style="height: 100px;"></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="height: 100px;"></td> <td></td> <td></td> <td></td> </tr> </table> <p style="text-align: center; margin-top: 10px;">Tonto Alpine #1 Federal approximate location see attached survey plat for exact location</p> </div> <div style="width: 40%;"> <p style="text-align: center;">CERTIFICATION</p> <p>I hereby certify that the information above is true and complete to the best of my knowledge and belief.</p> <p>Name <u>George A. McLaren</u> Vice President/General Position <u>Manager</u> <u>Tonto Drilling Services,</u> Company <u>Inc.</u></p> <p>Date <u>April 30, 1993</u></p> <p>I hereby certify that the well location shown on the plat was plotted from field notes of actual surveys made by me or under my supervision, and that the same is true and correct to the best of my knowledge and belief.</p> <p>Date Surveyed _____</p> <p>Registered Professional Engineer and/or Land Surveyor see attached survey plat</p> <p>Certificate No. _____</p> </div> </div>													

PROPOSED CASING PROGRAM

Size of Casing	Weight	Grade & Type	Top	Bottom	Cementing Depths	Sacks Cement
6 1/2 Cond	N/A	N/A	0	20	0 -20	2-3
4 1/2 Surf	11.4lbs/ft	HWL	0	500	0-500	25-30
1 1/2 Liner	N/A	N/A	0	4,500	bottom h	2-3



1	2	3	1 Eager
			2 Nelson Reservoir
			3 Loco Knoll
4		5	4 Rock Knoll
			5 Escudilla Mountain
			6 Buffalo Crossing
			7 Alpine
6	7	8	8 Lama Lake

ROAD LEGEND

- Improved Road
- Unimproved Road
- Trail
- Interstate Route
- U.S. Route
- State Route

NUTRIOSO, ARIZONA
PROVISIONAL EDITION 1991

**This SURVEY was done by me and in 1938 and
 cannot be the best of my knowledge and belief.**

NO

A WELL AND SITES LOCATED IN
SW 1/4 OF SECTION 23, T.6 N., R.30 E. G. & S.R.M.
APACHE COUNTY, ARIZONA

THE DISTANCE IS FROM THE WEST AND SOUTH LINES OF SECTION 23, T.6 S., R.30 E. G. & S. 34 M.

WELL OR SITE	DISTANCE FROM WEST LINE	DISTANCE FROM SOUTH LINE
SITE	1152.00'	2122.36'

WELL OR SITE COURSE FROM 1/4 CORNER ELEVATION
SITE S84°34'07"E-1260.56' 8355.56'

ELEVATION AT THE EXISTING WELL WAS TO THE TOP OF CASENO
TO GROUND AT THE SITES. NOS 1988 ELEVATION 8405.974'
THE BASE ELEVATION WAS 8400-- NOS 1988 ELEVATION 8405.974'
THE COURSES SHOWN IS FROM THE 1/4 OF SECTIONS 22 & 23

\$ 8877.00° E
2511.98'

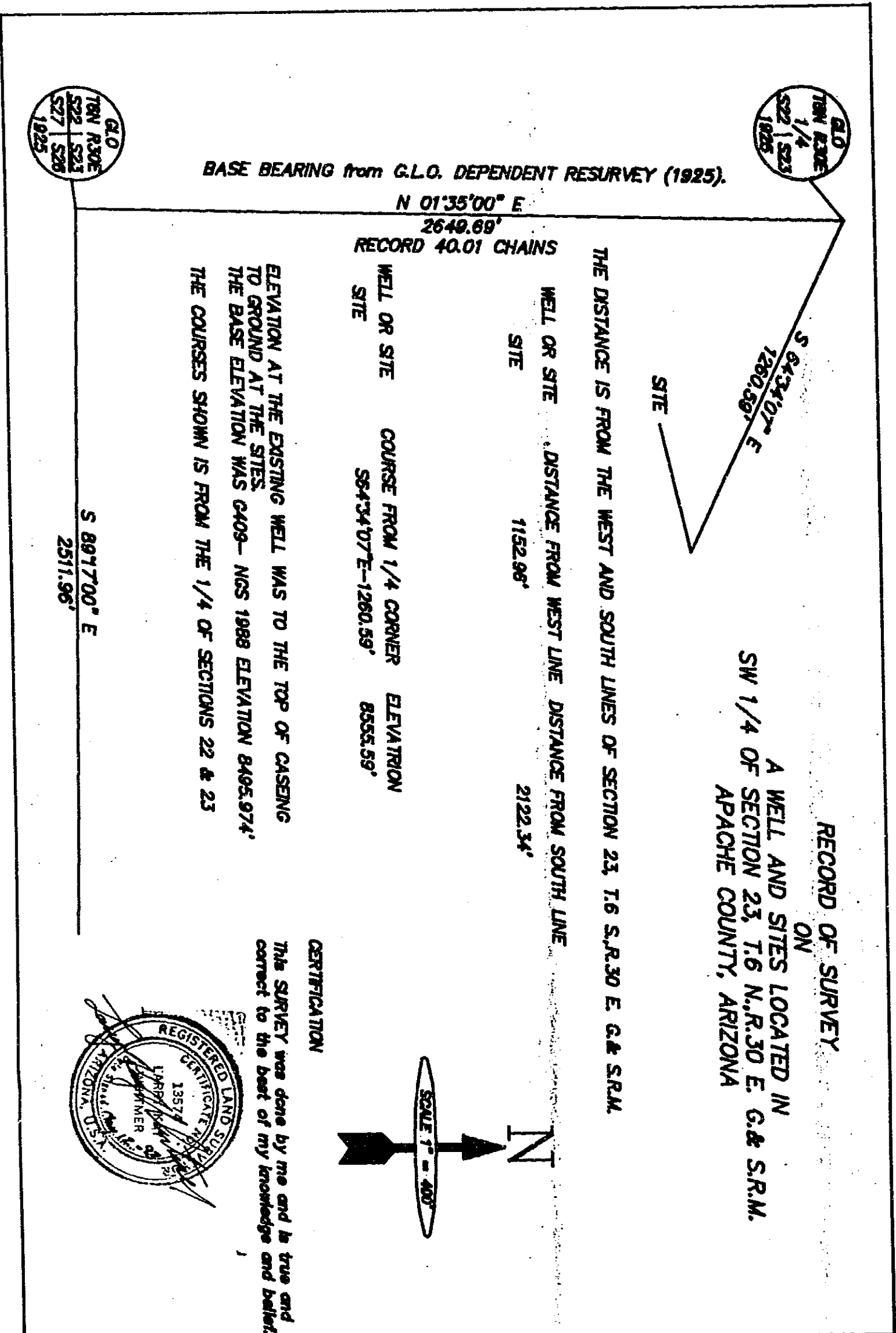
CERTIFICATION

**THIS SURVEY WAS DONE BY ME AND IS TRUE AND
CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.**

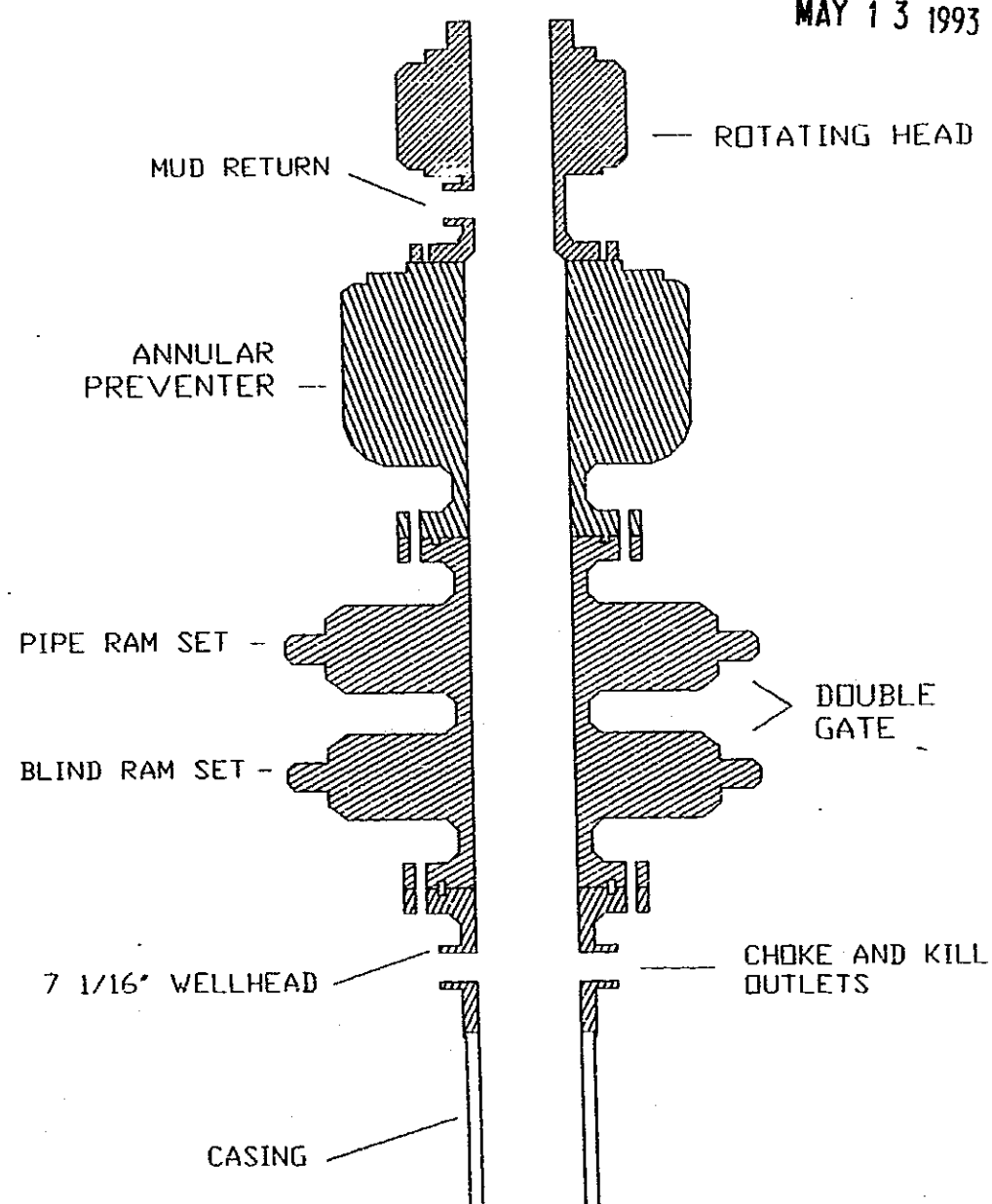


BASE BEARING FROM G.O. DEPENDENT RESERVE (1925).

N 01.35.00° E
2648.88'
RECORD 10.01 CHAINS

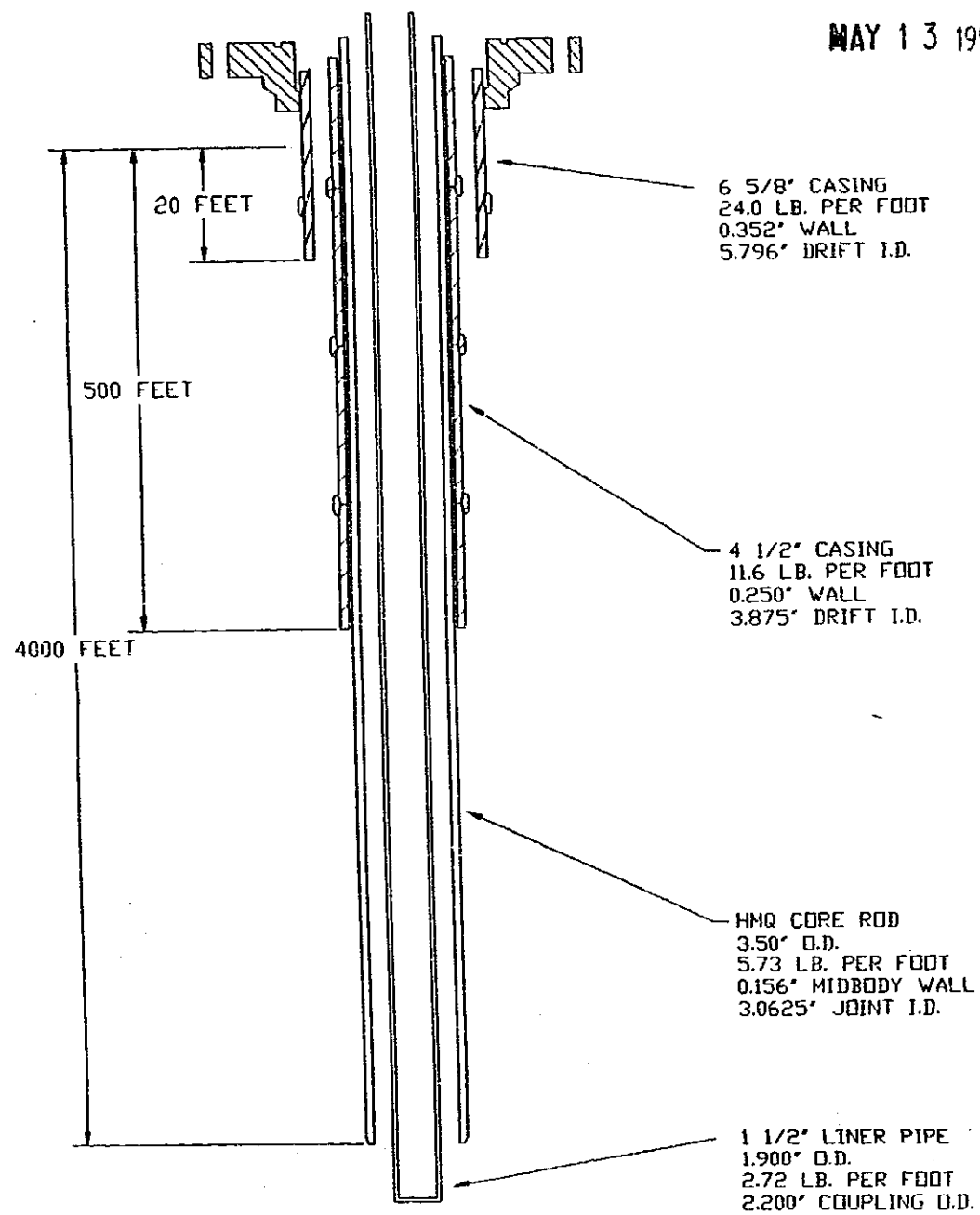


MAY 13 1993



BOP STACK
ALPINE DIVIDE CORE HOLE

MAY 13 1993



HOLE PLAN
ALPINE DIVIDE CORE HOLE

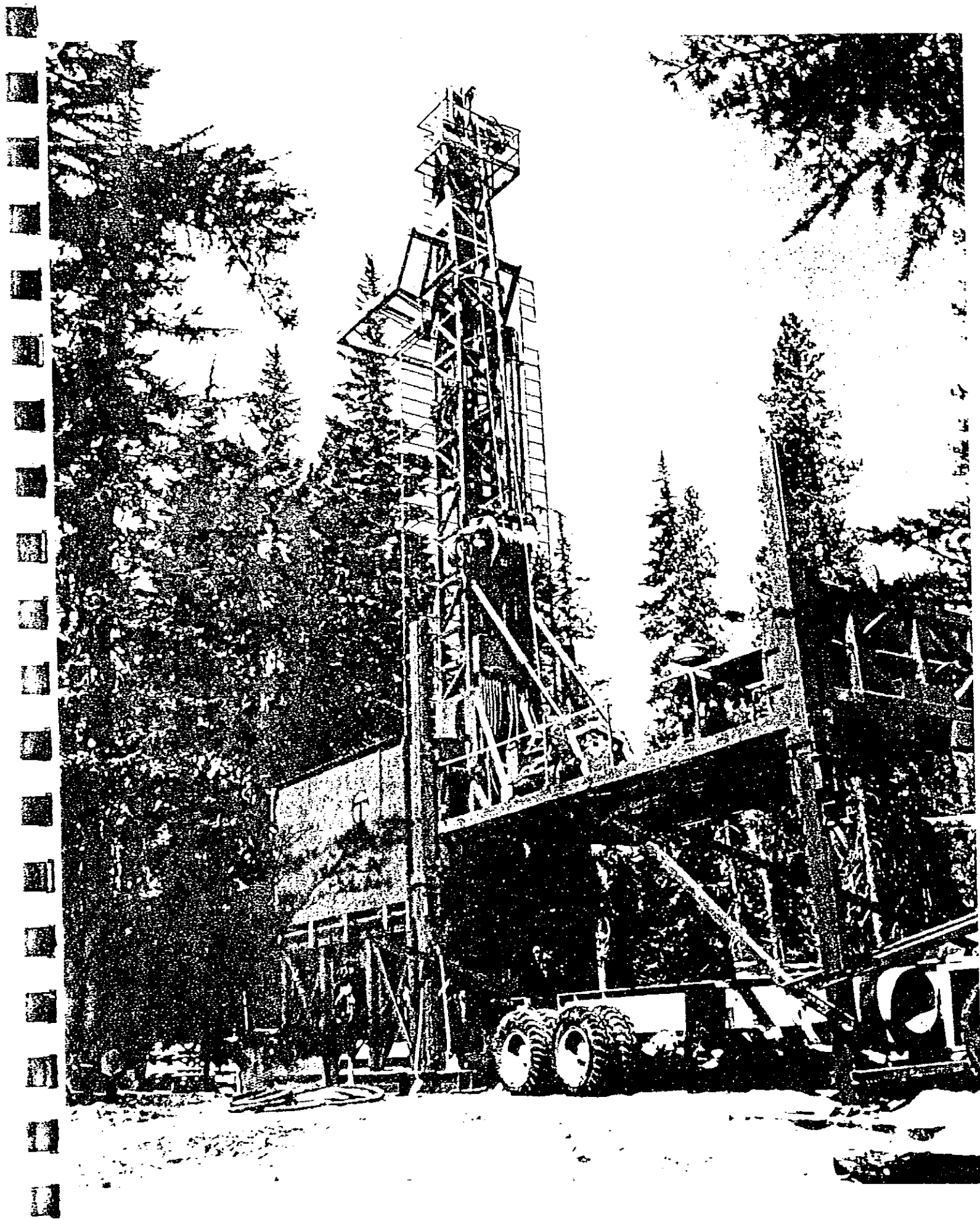
HR rod is 3.5" O.D.; 2.5" I.D.
 NR rod is 2 3/4" O.D.; 1 7/8" (1.875") I.D.
 BR rod is 2 1/16" O.D.; 1 7/16" (1.432") I.D.



TECHNICAL DATA

UDR 1500

Mounting	Truck or Trailered	Removable from a 5 axle carrier	
	Length	52' 6"	
	Width	8' 2"	
	Height	11' 6"	
	Weight	42,900 lbs.	
Power	Drill Engine	Detroit 671 230 HP	
	Generator	8 Kw Hydraulic	
Derrick	Rod Capacity	40 ' Rod Stands	
	Angle Capability	-45 to -90 degrees	
	Max. Casing Diameter	16 inch	
	Max. Casing Length	Range 2 (25' to 34')	
Hoist	Single Line Pull	36,000 lbs.	
	Double Line Pull	72,000 lbs.	
	Pulling Speed	0 to 300 FPM	
Rotation	Type	Hydraulic Top Drive	
	Feed Length	24'	
	Maximum Torque	5630 lb./ ft.	
	Speed Range	0 to 1500 RPM	
	Pull Back	32,000 lbs.	
	Pull Down	15,700 lbs.	
Pump	Type	Hydraulically Driven	
	Model	FMC Bean L1122B	
	Max. Flow Rate	40 GPM	
	Maximum Pressure	1,000 PSI	
Wireline	Type	Hydraulic c/w spooler	
	Line Pull	4,200 lbs.	
	Cable Size	5/16"	
	Capacity	6,560 feet	
Ancillary Equipment			
	12' 6" Clearance Sub-Structure for BOP Equipment		
	Self erecting up to sub-structure		
	Hydraulic Footclamp and break-out tool		
	Full 110 volt Lighting System		
Depth Capacity	NCQ	3.040" Hole 1.875" Core	7,100 feet
	CHD 76	3.040" Hole 1.713" Core	5,640 feet
	HMQ	3.850" Hole 2.50" Core	5,400 feet
	CHD 101	4.25" Hole 2.50" Core	3,670 feet



9105881

28427

REFERENCE	AMOUNT	REFERENCE	AMOUNT	REFERENCE	AMOUNT
Job #313	\$25.00				
TOTAL			\$25.00		

TONTO DRILLING SERVICES, INC.

ORGANIZATION REPORT

Full Name of the Company, Organization, or Individual

TONTO DRILLING SERVICES, INC.

Mailing Address and Phone Number

2200 South 4000 West, Salt Lake City, UT 84120 (801)974-0645

Plan of Organization (State whether organization is a corporation, joint stock association, firm or partnership, or individual)

Corporation

Purpose of Organization (State type of business in which engaged)

Provide contract drilling services

If a reorganization, give name and address of previous organization

If a foreign corporation, give (1) State where incorporated	(2) Name and mailing address of state agent	(3) Date of permit to do business in state
Delaware	C T Corporation 3225 North Central Ave. Phoenix, AZ 85012	Nov. 20, 1989
Principal Officers or Partners (if partnership) NAME	TITLE	MAILING ADDRESS
Noble H. Larsen	President	2200 South 4000 West Salt Lake City, UT 84120
George A. McLaren	Vice President	(Same)
Arnold Klassen	Secretary/Treasurer	(Same)

DIRECTORS NAME

MAILING ADDRESS

W. R. Dengler

2 E. Beaver Creek Rd. #2, Richmond Hill, Ontario
L4B 2N3

Noble H. Larsen

2200 South 4000 West, Salt Lake City, UT 84120

CERTIFICATE: I, the undersigned, under the penalty of perjury, state that I am the Secretary of the Tonto Drilling Services, Inc. (company), and that I am authorized by said company to make this report; and that this report was prepared under my supervision and direction and that the facts stated therein are true, correct and complete to the best of my knowledge.

Signature

Arnold Klassen

April 23, 1993

Date

Mail completed form to:
Oil and Gas Program Administrator
Arizona Geological Survey
845 N. Park Ave., #100
Tucson, AZ 85719

STATE OF ARIZONA
ARIZONA GEOLOGICAL SURVEY

Organization Report
File One Copy

Form No. 1

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS

Bond Serial No. 115574

That we: TONTO DRILLING SERVICES, INC.

of the County of SALT LAKE CITY in the State of UTAH

as principal, and THE INSURANCE COMPANY OF THE STATE OF PENNSYLVANIA

of 70 PINE STREET, NEW YORK, NY 10270
AUTHORIZED TO DO BUSINESS WITHIN the State of Arizona.

as surety, are held and firmly bound unto the State of Arizona and the Oil and Gas Conservation Commission, hereinafter referred to as the "Commission", in the penal sum of --- FIVE THOUSAND AND 00/100 --- (\$5,000.00) lawful money of the United States, for which payment, well and truly to be made, we bind ourselves, and each of us, and each of our heirs, executors, administrators or successors, and assigns jointly and severally, firmly by these presents.

The conditions of this obligation are that, whereas the above bounden principal proposes to drill a well or wells for a Geothermal Resource or stratigraphic purposes in and upon the following described land situated within the State, to-wit:

Well No. Alpine #1, Alpine Field or Area, Sec 23, T6N, R30E
(May be used as blanket bond or for single well)

NOW, THEREFORE, if the above bounden principal shall comply with all the provisions of the Laws of this State and the rules, regulations and orders of the Commission, especially with reference to the requirements of A.R.S. § 27-652, providing for the proper drilling, casing and plugging of said well or wells, and filing with the Oil and Gas Conservation Commission all notices and records required by said Commission, then in the event said well or wells do not produce Geothermal Resources in commercial quantities, or cease to produce a Geothermal Resource in commercial quantities, this obligation is void; otherwise it shall remain in full force and effect.

Whenever the principal shall be, and declared by the Oil and Gas Conservation Commission in violation of the Laws of this State and the rules, regulations and orders of the Commission, the surety shall promptly:

1. Remedy the violation by its own efforts, or
2. Obtain a bid or bids for submission to the Commission to remedy the violation, and upon determination by the Commission and the Surety of the lowest responsible bidder, arrange for a contract between such bidder and the Commission, and make available as work progresses sufficient funds to pay the cost of remedying the violation; but not exceeding, including other costs and damages for which the surety may be liable hereunder, the amount set forth in the first paragraph hereof.

Liability under this bond may not be terminated without written permission of this Commission.

WITNESS our hands and seals, this day of APRIL, 19 93.

TONTO DRILLING SERVICES, INC.

Principal

WITNESS our hands and seals this 27th day of APRIL, 19 93.

THE INSURANCE COMPANY OF THE STATE OF PENNSYLVANIA

DONALD A. FINDLAY,

Surety

Attorney-In-Fact

Countersigned By Linda Albert
Linda Albert, AZ Resident Agent

Surety, Resident Arizona Agent
(If issued in a state other than Arizona)

(If the principal is a corporation, the bond should be executed by its duly authorized officers, with the seal of the corporation affixed. When principal or surety executes this bond by agent, power of attorney or other evidence of authority must accompany the bond.)

Approved
Date

5-18-93

STATE OF ARIZONA
OIL & GAS CONSERVATION COMMISSION

By:

Steven L. Ranz

STATE OF ARIZONA
OIL & GAS CONSERVATION COMMISSION

Bond

File Two Copies

Form No. G-2

Permit No.

878

The Insurance Company of the State of Pennsylvania
Principal Bond Office: 70 Pine Street, New York, N.Y. 10270

POWER OF ATTORNEY

No. _____

KNOW ALL MEN BY THESE PRESENTS:

That The Insurance Company of the State of Pennsylvania, a Pennsylvania corporation, does hereby appoint

---Shelley Hooper, Pina Ialungo, Donald A. Findlay: of Vancouver, B. C. Canada---

its true and lawful Attorney(s)-in-Fact, with full authority to execute on its behalf bonds, undertakings, recognizances and other contracts of indemnity and writings obligatory in the nature thereof, issued in the course of its business, and to bind the company thereby.

IN WITNESS WHEREOF, The Insurance Company of the State of Pennsylvania has executed these presents



this 21 day of June, 1991.

Mark E. Reagan
Mark E. Reagan, Senior Vice President

STATE OF NEW YORK)
COUNTY OF NEW YORK) ss.

On this 21 day of June, 1991,
before me came the above named officer of The Insurance
Company of the State of Pennsylvania, to me personally known to
be the individual and officer described herein, and acknowledged
that he executed the foregoing instrument and affixed the seal of
said corporation thereto by authority of his office.

CANCELLED
DATE 7-18-94 *ELR*
JOSEPH B. NOZZOLIO
Notary Public, State of New York
No. 01-NO4652754
Qualified in Westchester County
Term Expires Jan. 31, 1992

CERTIFICATE

Excerpts of Resolution adopted by the Board of Directors of The Insurance Company of the State of Pennsylvania, on May 18, 1976:

*RESOLVED, that the Chairman of the Board, the President, or any Vice President be, and hereby is, authorized to appoint Attorneys-in-Fact to represent and act for and on behalf of the Company to execute bonds, undertakings, recognizances and other contracts of indemnity and writings obligatory in the nature thereof, and to attach thereto the corporate seal of the Company, in the transaction of its surety business;

*RESOLVED, that the signatures and attestations of such officers and the seal of the Company may be affixed to any such Power of Attorney or to any certificate relating thereto by facsimile, and any such Power of Attorney or certificate bearing such facsimile signatures or facsimile seal shall be valid and binding upon the Company when so affixed with respect to any bond, undertaking, recognizance or other contract of indemnity or writing obligatory in the nature thereof;

*RESOLVED, that any such Attorney-in-Fact delivering a secretarial certification that the foregoing resolutions still be in effect may insert in such certification the date thereof, said date to be not later than the date of delivery thereof by such Attorney-in-Fact."

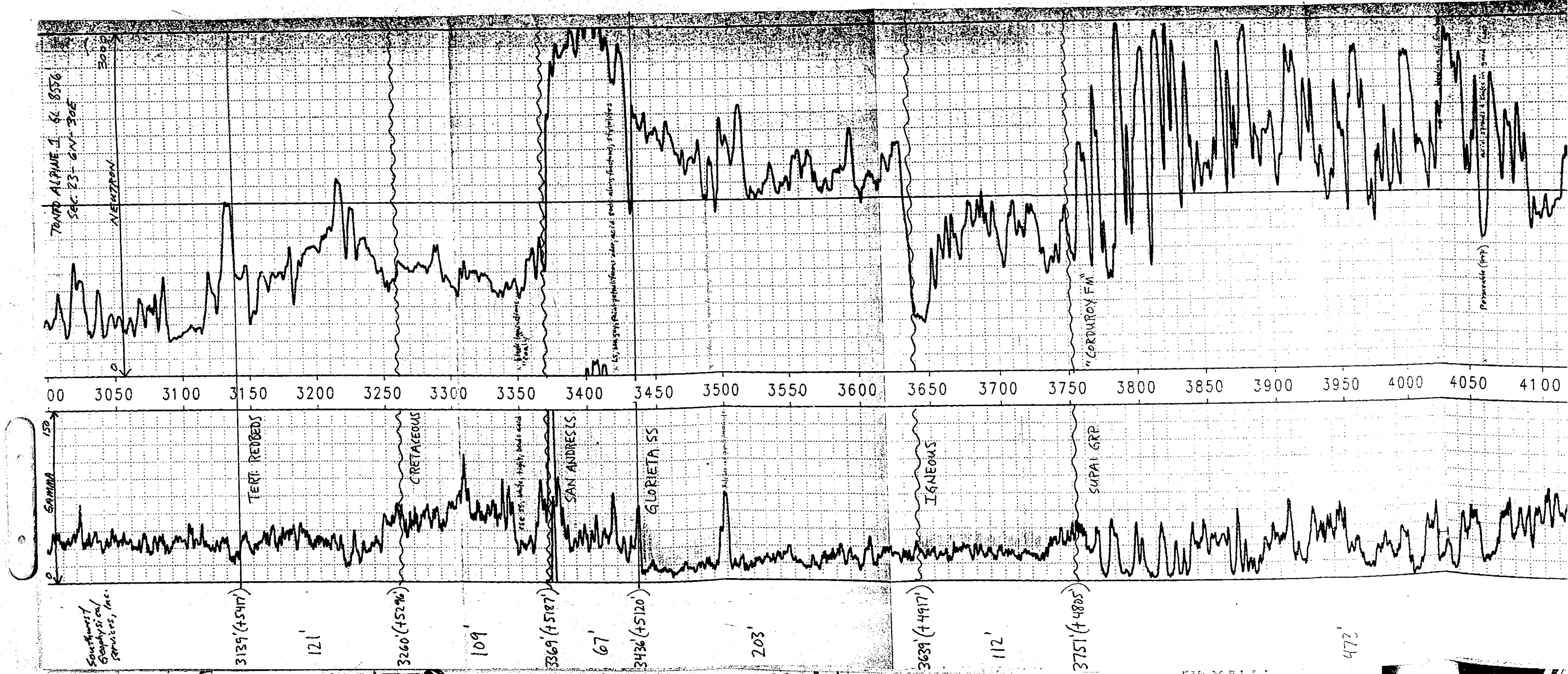
I, Elizabeth M. Tuck, Secretary of The Insurance Company of the State of Pennsylvania, do hereby certify that the foregoing excerpts of Resolution adopted by the Board of Directors of this corporation, and the Power of Attorney issued pursuant thereto, are true and correct, and that both the Resolution and the Power of Attorney are in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the facsimile seal of the corporation



this 27TH day of APRIL, 1993.

Elizabeth M. Tuck
Elizabeth M. Tuck, Secretary



ARIZONA GEOLOGICAL SURVEY

1-ALPINE FEDERAL WELL

Permit No. 878

Sample Analyses

Samples were analyzed to determine their organic richness, petroleum content, kerogen type, and maturity by TOC and Rock-Eval analyses. Confirmation of maturity on selected samples was completed using vitrinite reflectance and thermal alteration index (TAI) analyses. Free petroleum content was characterized by thermal extraction/gas chromatography fingerprinting. Pyrolysis/gas chromatography was utilized to further characterize kerogen type. Bulk kerogen decomposition kinetic parameters were determined on one source interval to evaluate the temperature and timing thresholds for conversion of organic matter into petroleum.

Discussion of Results

TOC and Rock-Eval Data

The TOC and Rock-Eval analytical results are shown in Table 1. This table shows sample information with respective measured analytical results and calculated interpretive ratios. These data may be summarized as follows:

TOC	organic richness
S1	amount of free petroleum
S2	remaining kerogen potential to generate petroleum
S3	organic carbon dioxide content
Tmax	thermal maturity based on peak yield from Rock-Eval S2 peak
HI	hydrogen index, an important indicator of kerogen type - oil/gas proneness
OI	oxygen index, an indicator of kerogen type
S2/S3	a ratio indicative of kerogen type
PI	production index ($S1 / (S1+S2)$), indicative of free petroleum content
S1/TOC	normalized petroleum content, indicative of indigenous/migrated petroleum content

Note: When the measured TOC and Rock-Eval data are very low, e.g., TOC < 0.20%, the interpretive ratios are not reliable.

Also shown on these data tables are indications of quality control such as check analyses and pyrogram quality. Approximately 20% of samples are selectively and randomly checked; a confirmed analysis has a "c" noted in the "check" column. The pyrogram is a graphic representation of the Rock-Eval S2 peak and assists in evaluation of the analytical data. If the S2 value is low (< 0.50 mg hydrocarbons/gram rock) and the S2 pyrogram is flat, the Rock-Eval Tmax value is not usually accurate due to the difficulty of finding a maximum on a flat peak. However, samples having low S2 values but a distinct S2 peak have a Tmax value reported.

Vitrinite Reflectance and Visual Kerogen Data

Four samples were analyzed by microscopy to determine vitrinite reflectance and visual kerogen (maceral) composition to confirm Rock-Eval Tmax maturity assessments (Table II). Analyses of these samples were completed on isolated kerogens which were subsequently mounted in plugs (for vitrinite reflectance measurements and fluorescence) and on slides (for maceral composition assessment). The vitrinite histograms with indigenous and total population statistics and measured data are shown in Appendix I.

Thermal Extract - Pyrolysis / Gas Chromatography Data

Thermal extract / gas chromatography (TE/GC) fingerprints were obtained using whole rock samples. The free petroleum in these rocks was vaporized using a 335°C temperature isotherm for 5 minutes. This is a comparable vaporization temperature used to determine the Rock-Eval S1 peak. Although the Rock-Eval S1 is usually programmed as 300°C temperature isotherm, the true temperature is 30-40°C hotter than this nominal temperature program. The petroleum products vaporized from the rock are trapped directly onto a capillary GC column using liquid nitrogen. Subsequently, the products are chromatographed and detected resulting in the separation of compounds. The GC trace is referred to as a fingerprint since it characterizes the petroleum present in the rock. These fingerprints can be likened to histograms or bar graphs with the peaks representing the relative concentration of compounds to one another. Loss of the lightest components (<C8) occurs due to evaporation in sample handling and storage.

Pyrolysis / gas chromatography (PGC) was accomplished by heating the samples at 25°C/minute from 335°C to 550°C. The pyrolysis products were trapped in a capillary GC column and subsequently chromatographed. The typical PGC fingerprint completed by this methodology yields a homologous series of doublets of the same carbon number consisting of alkene-alkane pairs with other hydrocarbons, both saturated and aromatic, eluting between these doublets.

Kinetic Analysis of Potential Oil Source Rocks

One sample having strong oil potential, the 3975 foot shale sample of the Corduroy formation sample of the Permian Supai Group, was analyzed to determine kerogen decomposition kinetic parameters. Source rock kinetic parameters permit description of the timing of decomposition of organic matter which is dependent on kerogen composition as well as temperature and time (Tissot and Espitalie, 1975; Ungerer and Pelet, 1987). Pyrolysis data were acquired at multiple heating rates (1, 5, 10, 15, and 30°C/minute) while measuring both the detector response and true (absolute) temperatures in the sample. A unique technique for precisely measuring temperatures was utilized requiring no linearization or offset corrections to temperatures. The reduced data files were then processed in the rigorous discrete and Gaussian models of the Lawrence Livermore National Laboratory's Kinetics© program.

Only immature samples may be utilized for kinetic analysis.

Interpretation

Analysis of core samples from the 1 Alpine-Federal geothermal well in Apache county, Arizona revealed a number of organic rich intervals. A plot of remaining generation potential (Rock-Eval S2 value) versus TOC shows numerous intervals with greater than 1.00% TOC, the typical minimum organic carbon content for a potential petroleum source rock (Figure 1). The values plotted as an "x" are samples having less than 1.00% TOC whereas the "o" values have TOC contents greater than 1.00%. Values less than 1.00% TOC generally have insignificant petroleum potential and are not usually worth further investigation as potential petroleum source rocks (Baker, 1961).

Intervals at 3294, 3305, and 3340 feet in the Cretaceous have TOC values of 3.11%, 6.59%, and 8.58%, respectively. Likewise, the Permian San Andres limestone reaches 12.77% TOC at 3397 feet and 3.70% at 3410 feet. In the Corduroy formation of the Supai group of Permian age, numerous intervals exceed 1.00% TOC with values over 1.00% ranging from 1.40% to 7.21%. A Fort Apache member of the Supai group measures 4.25% at 4235 feet.

Figure 1 also illustrates the potential for oil and gas of these samples. The Cretaceous intervals are largely gas prone whereas the Permian age samples are more oil prone or have mixed oil/gas potential based on these Rock-Eval S2 and TOC values only. This is also illustrated by a classical modified van Krevelen plot of hydrogen index (Rock-Eval S2 x 100 / TOC) versus oxygen index (Rock-Eval S3 x 100 / TOC) (Figure 2) (Espitalie *et al*, 1977).

Jones (1984) defined the principal products of various kerogen types by HI and OI values as well as by confirmation utilizing elemental and visual kerogen assessment (see Appendix II). Based on HI values only, the Tertiary section is organic lean having no source potential. In the Dakota sandstone of Cretaceous age, there are three organic rich zones. All three zones have HI values which indicate terrestrial derived kerogen which would yield primarily gas upon maturation. In the Permian numerous organic rich zones contain either mixed oil/gas or oil potential based on HI values ranging from 219 to 517. Additional evaluation of kerogen type is discussed in later sections of this report.

A plot hydrogen index versus Rock-Eval Tmax illustrates the remaining petroleum potential with regard to thermal maturity (Figure 3) (Espitalie *et al*, 1984). The majority of the samples are early to mid-oil window in maturity. Two of the organic rich Cretaceous samples have unusually high Tmax values when compared to samples above and below the Cretaceous.

Assessment of samples by vitrinite reflectance and visual kerogen analysis confirms the anomalous maturity profile but this may be due to the nonautochthonous coaly particles (Tables II and Appendix I report and maceral table). However, while the Tmax values may be indicative of more advanced maturity, the lower maturity predicted by vitrinite reflectance assessment (0.63% Ro) is corroborated by the low level conversion of organic matter as indicated by the low production index (<0.05). These Ro and PI values are indicative of 2-10% conversion of kerogen only, i.e., immature to early oil window maturity.

In the lower Fort Apache and Amos Wash Permian Supai Group intervals, very high maturities are indicated by the high Tmax values at 4405 and 4428 feet. While the S2 values are very low in these samples, the S2 peaks have distinct maxima yielding accurate Tmax values. These Tmax values are indicative of gas window maturity suggesting elevated temperature exposures at and below these depths.

Evaluation of Oil Shows

Both dead oil and oil shows were reported at the contact of the Tertiary and Cretaceous, below the San Andres limestone and 196 feet above the top of the Fort Apache unit in the Corduroy formation (4,028 feet). An interpretive ratio from TOC and Rock-Eval S1 data is very useful in predicting shows or reservoir intervals. Depending on sample preservation these data may be used to predict gas or oil reservoirs (Jarvie and Baker, 1984). Since reservoir rocks have high free petroleum content relative to TOC content, e.g., sandstones, when the S1/TOC ($\times 100$) ratio exceeds a value of 100 shows or productive intervals are indicated in the absence of extraneous contamination such as diesel. Potential source rocks in the main phase of oil generation will have much higher S1/TOC ratios than nonsource rocks but will generally have S1/TOC ratios that range from 40 to 80. However, fractured shale reservoirs such as found in the Monterey or Bakken shales, will have S1/TOC ratios greater than 100.

The zones at the Tertiary/Cretaceous boundary have extremely low concentrations of petroleum (< 40 ppm) in intervals between 3156 and 3285 feet. While light hydrocarbons could have evaporated from these samples in storage or sample preparation, the low level of higher hydrocarbons is not indicative of oil shows.

The zone in the Permian Supai group at 4028 feet has a high S1 value (2,430 ppm) and reasonably high S1/TOC ($\times 100$) ratio (69). However, this zone has the characteristics of an organic rich, oil prone petroleum source rock. The TE/GC trace reveals an immature, waxy oil fingerprint (Figure 4.a). Thus, this show is actually caused by *in situ* generation of oil in a potential oil source rock. The pristane/phytane ratio derived from the TE/GC is 0.83 indicative of a reducing depositional environment.

Other zones were also fingerprinted by TE/GC. Two zones in the Cretaceous Dakota formation were fingerprinted. The 3305 feet zone yielded primarily light hydrocarbons characteristic of a gas prone rock (Figure 4.b). The 3340 feet zone has slightly more hydrocarbons above C15 than the 3305 feet zone reflecting its slightly higher HI value (100 vs. 54) (Figure 4.c). However, the principal products are light hydrocarbons. The pristane to phytane ratio exceeds 3 indicative of oxidative depositional environments and terrestrial organic matter input.

The organic rich zone at 3397 feet in the Permian San Andres limestone also yields primarily light hydrocarbons (Figure 4.d) as indicated by the gas prone nature of this sample based on its HI value. The sample at 3410 feet, however, has a more complex fingerprint and contains compounds evolving above C15 including an unresolved envelope from C10 to C30 (Figure 4.e). These are largely nonhydrocarbon petroleum compounds such as resins and asphaltenes which are

not resolved by GC techniques. The oil prone but immature nature of this zone is confirmed by this fingerprint. The pristane/phytane ratio is 2.83.

The zone at 3878 feet in the Permian Corduroy formation of the Supai Group has an HI value of 382 and the TE/GC fingerprint reflects its low maturity, oil potential (Figure 4.f). The TE/GC fingerprint contains an abundance of compounds eluting above C15 with terrestrial input indicated by the C30+ hydrocarbons. The pristane/phytane ratio is 2.39.

The 3975 feet zone of the Corduroy formation has TE/GC fingerprint indicative of lower terrestrial organic matter input than the 3878 feet interval (Figure 4.g). There is an abundance of light hydrocarbons indicative of the tighter, nonporous nature of this sample. Hydrocarbons above C15 are abundant and the pristane to phytane ratio is 1.17.

The Fort Apache member sample at 4235 feet from the Permian Supai Group yields a strong immature oil-like fingerprint from TE/GC (Figure 4.h). There are abundant hydrocarbons present up to C30+ with a significant unresolved component beneath the resolved peaks from C10 to C30. The pristane/phytane ratio is 1.75.

A plot of the relationship of the branched alkanes of biological origin, pristane and phytane, to the straight chain alkanes, C17 and C18, respectively, is indicative of the depositional environment and maturity off these organic rich zones (Figure 5).

Further Evaluation of Kerogen Type from Pyrolysis/Gas Chromatography Fingerprints

Pyrolysis/gas chromatography fingerprints provide a non-petroleum fingerprint of the present day potential of the kerogen to yield oil or gas. Immature gas prone kerogens have PGC fingerprints with low concentrations of normal alkanes especially above C15, a large number of non-alkene/alkane peaks, and high relative amounts of aromatic compounds such as benzene, toluene, and xylenes. On the other hand, immature oil prone kerogens have relatively high amounts of alkene-alkane pairs above C15 with variable amounts of intermediate peaks and low relative amounts of aromatics.

The gas prone kerogens are confirmed by the PGC fingerprints of samples at depths of 3305, 3340, 3397, and 3410 feet (Figure 6.b - 6.e). These fingerprints have relatively low amounts of hydrocarbons above C15 with relatively large amounts of aromatics to alkene-alkane pairs. The 3410 feet sample, despite its relatively high HI value and low maturity, is more gas prone than expected.

On the other hand, the oil prone kerogens are represented by PGC fingerprints of samples at depths of 3878, 3975, 4028, and 4235 feet (Figures 6.a - 6.f-h). There are abundant alkene-alkane pairs extending beyond C15, generally with low amounts of intermediate peaks although the sample at 4235 feet does have a more complex mixture of hydrocarbons. These PGC data confirm the oil prone nature of these zones.

Kinetic Data

The immature 3975 foot sample of the Corduroy formation of the Permian Supai Group was analyzed to determine kerogen decomposition kinetics. These results are shown in Table III. A bar graph of the distribution of activation energies is shown in Figure 7 with the calculated Arrhenius factor (A). The distribution of activation energies is very narrow with over 75% of the kerogen decomposition characterized by a single activation energy. This indicates that the formation of petroleum will occur rapidly over a very narrow range of temperatures and time. This is illustrated by modeling these kinetic data using a constant heating rate geological model by increasing the temperature at 3.3°C per million years. This heating rate may not necessarily be appropriate for this area but permits comparison to other kerogens. In fact changes in the heating rate will cause the temperatures of 10%, 50% and peak generation to shift - if the heating rate is slower, the temperatures will be lower; if the heating rate is faster, the temperatures will be higher.

Using the discrete model kinetic data in a 3.3°C/my constant heating rate model, the generation rate reaches a maximum at 150°C at a computed vitrinite reflectance value (%Ro) of 0.99% (Figure 8).

A plot of the transformation ratio, i.e., the percentage conversion of kerogen to oil or gas, versus temperature using the 3.3°C/my model illustrates the transformation of kerogen to oil (Figure 9). Based on the measured kinetic parameters and this constant heating rate model, 10% generation or the onset of generation, would be reached at 136°C or a computed vitrinite reflectance (%Ro) equivalent of 0.82%. A transformation of 50%, approximately peak generation, would be reached at a temperature of 148°C or 0.96% Ro. The analytical accuracy of these results is typically 5°C. Note the steep slope of the Corduroy formation transformation curve (solid triangles) indicative of the homogenous organic matter in this sample.

How do these results compare to other known petroleum source rocks? Figure 9 compares the transformation ratio of the Corduroy formation sample at 3,975 feet to other kerogens. These results are nearly identical to the Type I (Green River shale) modeled at the identical constant heating rate which decomposes at temperatures slightly higher than the Type IID Woodford shale up to approximately 65% transformation. The Type IIB, IIS, and III kerogens are represented by Kimmeridge shale, a sulfur-rich Monterey formation, and Indiana coal samples, respectively. The computed Rock-Eval Tmax values for the onset of generation (10% transformation ratio) and peak generation would be 441°C and 449°C, respectively, assuming a 35°C correction from true temperatures calculated using these kinetics. This narrow Tmax range is typical of homogenous organic matter yielding primarily paraffinic oil upon maturation.

Conclusions

The 1 Alpine-Federal well is characterized by numerous organic rich but thermally immature intervals. Potential gas, mixed oil/gas, and oil source rocks are present but their potential as commercial oil or gas source rocks is dependent on the maturity and volume of organic rich rocks which would cause generation and expulsion of commercial volumes of oil or gas as well as on

other components of a viable petroleum system including migration pathway, trap, seal, etc. (Magoon and Dow, 1994).

The Cretaceous rocks are organic rich but the richness is largely derived from coaly material that is hydrogen poor. The hydrogen indices and visual kerogen analysis indicate that these kerogens are primarily gas prone.

The Permian age rocks are oil prone or mixed oil/gas prone organic matter based on both HI values and visual kerogen assessment. However, these older rocks are immature based on Rock-Eval Tmax and vitrinite reflectance values. Their remaining potential to generate liquid petroleum products is high. In areas where they may be more mature, they have the capability to generate from 128 to 617 barrels of petroleum per acre-foot based on conversion of their present day potential (Rock-Eval S2 values). Their potential as petroleum source rocks is largely dependent on volumetric considerations and thermal maturity.

In the basal Fort Apache member and the Amos Wash formation of the Permian Supai Group, the high Tmax values are indicative of advanced thermal exposure and maturation.

The oil show reported in the well in the Corduroy formation is related to *in-situ* generation of oil in an organic rich interval. No other shows were detected from geochemical evaluation of these samples.

One organic rich, oil prone sample at 3,975 feet decomposes over a narrow time and temperature range based on calculated kerogen decomposition kinetics. Its decomposition is nearly identical to the Type I Green River shale, an oil prone, lacustrine source rock.

Report by: Daniel M. Jarvie
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Humble Instruments & Services, Inc.

Date: January 9, 1995

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Table I.1

ARIZONA GEOLOGICAL SURVEY

WELL NAME: #1 Alpine-Federal
ATTN: Steven Rauzi

ATTN: Steven Rauzi

ATTN: Steven Rauzi			TOC AND ROCK-EVAL DATA				INTERPRETIVE RATIOS				NOTES		
SAMPLE NO.	DEPTH (ft)	AGE/FORMATION	TOC	S1	S2	S3	TMAX	HI	OI S2/S3	PI	SI/TOC	Check Program	
1	504	Tertiary:	0.05	0.04	0.01	0.16	---	20	320	0.06	0.80	80	f
2	553	Dasil fm	0.04	0.01	0.00	0.15	---	0	375	0.00	1.00	25	f
3	604		0.03	0.07	0.00	0.13	---	0	433	0.00	1.00	233	f
4	652		0.04	0.02	0.00	0.09	---	0	225	0.00	1.00	50	f
5	714		0.02	0.02	0.00	0.12	---	0	600	0.00	1.00	100	f
6													
7	754		0.07	0.03	0.00	0.18	---	0	257	0.00	1.00	43	f
8	804		0.02	0.01	0.00	0.10	---	0	500	0.00	1.00	50	f
9	854		0.04	0.01	0.02	0.11	---	50	275	0.18	0.33	25	f
10	904		0.05	0.01	0.00	0.11	---	0	220	0.00	1.00	20	f
11	954		0.04	0.01	0.01	0.15	---	25	375	0.07	0.50	25	f
12	1002		0.04	0.00	0.00	0.11	---	0	275	0.00	---	0	f
13	1054		0.04	0.01	0.00	0.10	---	0	250	0.00	1.00	25	f
14	1114	Tertiary:	0.04	0.01	0.00	0.16	---	0	400	0.00	1.00	25	f
15	1164	Baca fm.	0.06	0.01	0.00	0.19	---	0	317	0.00	1.00	17	f
16	1214		0.05	0.02	0.01	0.21	---	20	420	0.05	0.67	40	f
17	1274		0.04	0.01	0.00	0.15	---	0	375	0.00	1.00	25	f
18	1314		0.03	0.01	0.00	0.13	---	0	433	0.00	1.00	33	f
19	1384		0.05	0.00	0.00	0.11	---	0	220	0.00	---	0	f
20	1434		0.04	0.01	0.00	0.17	---	0	425	0.00	---	25	f
21	1481		0.05	0.00	0.00	0.21	---	0	420	0.00	---	0	f
22	1534		0.03	0.00	0.00	0.16	---	0	533	0.00	---	0	f
23	1584		0.07	0.01	0.01	0.13	---	14	186	0.08	0.50	14	f
24	1634		0.06	0.00	0.00	0.20	---	0	333	0.00	---	0	f
25	1694		0.06	0.01	0.00	0.11	---	0	183	0.00	1.00	17	f
26	1750		0.09	0.03	0.02	0.13	---	22	144	0.15	0.60	33	f

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Table I.2

ARIZONA GEOLOGICAL SURVEY													
WELL NAME: #1 Alpine-Federal ATTN: Steven Rauzi													
SAMPLE NO.	DEPTH (ft)	AGE/FORMATION	TOC AND ROCK-EVAL DATA				INTERPRETIVE RATIOS				NOTES		
			TOC	S1	S2	S3	TMAX	HI	OI	S2/S3	PI	SI/TOC	Check Program
26	1800		0.05	0.00	0.00	0.12	---	0	240	0.00	---	0	f
27	1848		0.06	0.01	0.01	0.13	---	17	217	0.08	0.50	17	f
28	1902		0.04	0.00	0.00	0.09	---	0	225	0.00	---	0	f
29	1953		0.03	0.00	0.00	0.14	---	0	467	0.00	---	0	f
30	2002		0.04	0.01	0.03	0.20	---	75	500	0.15	0.25	25	f
31	2052		0.04	0.01	0.00	0.16	---	0	400	0.00	1.00	25	f
32	2104		0.03	0.01	0.01	0.26	---	33	867	0.04	0.50	33	f
33	2164		0.04	0.00	0.01	0.12	---	25	300	0.08	0.00	0	f
34	2204		0.04	0.01	0.00	0.15	---	0	375	0.00	1.00	25	f
35	2254		0.03	0.01	0.00	0.17	---	0	567	0.00	1.00	33	f
36	2304		0.06	0.01	0.00	0.16	---	0	267	0.00	1.00	17	f
37	2364		0.07	0.01	0.00	0.15	---	0	214	0.00	1.00	14	f
38	2404		0.05	0.00	0.00	0.07	---	0	140	0.00	---	0	f
39	2464		0.03	0.00	0.00	0.16	---	0	533	0.00	---	0	f
40	2504		0.13	0.01	0.02	0.13	---	15	100	0.15	0.33	8	f
41	2560		0.06	0.01	0.01	0.06	---	17	100	0.17	0.50	17	f
42	2604		0.08	0.02	0.02	0.16	---	25	200	0.13	0.50	25	f
43	2663		0.14	0.04	0.02	0.12	---	14	86	0.17	0.67	29	f
44	2704		0.06	0.01	0.05	0.09	---	83	150	0.56	0.17	17	f
45	2754		0.06	0.00	0.00	0.07	---	0	117	0.00	---	0	f
46	2802		0.07	0.00	0.03	0.10	---	43	143	0.30	0.00	0	f
47	2862		0.12	0.01	0.05	0.14	---	42	117	0.36	0.17	8	f
48	2902		0.03	0.02	0.02	0.08	---	67	267	0.25	0.50	67	f
49	2966		0.09	0.01	0.04	0.09	---	44	100	0.44	0.20	11	f
50	3106		0.12	0.02	0.02	0.12	---	17	100	0.17	0.50	17	f

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Table I.3

ARIZONA GEOLOGICAL SURVEY

WELL NAME: #1 Alpine-Federal
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			TOC AND ROCK-EVAL DATA					INTERPRETIVE RATIOS					NOTES
SAMPLE NO.	DEPTH (ft)	AGE/FORMATION	TOC	S1	S2	S3	TMAX	HI	OI	S2/S1	PI	SI/TOC	Check Program
51	3156	Tertiary:	0.15	0.02	0.03	0.09	---	20	60	0.33	0.40	13	f
52	3206	(red beds)	0.10	0.02	0.10	0.09	---	100	90	1.11	0.17	20	f
53	3255		0.05	0.03	0.09	0.16	---	180	320	0.56	0.25	60	f
54	3265	Cretaceous:	0.08	0.01	0.08	0.07	429	100	88	1.14	0.11	13	n
55	3275	Dakota SS	0.80	0.04	0.56	0.11	432	70	14	5.09	0.07	5	n
56	3285		0.26	0.03	0.14	0.09	429	54	35	1.56	0.18	12	n
57	3294		3.11	0.06	2.67	0.17	436	86	5	15.71	0.02	2	c
58	3305		6.59	0.14	3.59	0.36	449	54	5	9.97	0.04	2	c
59	3315		0.90	0.03	0.96	0.16	433	107	18	6.00	0.03	3	n
60	3330		0.54	0.02	0.44	0.09	432	81	17	4.89	0.04	4	n
61	3340		8.58	0.43	8.60	0.60	444	100	7	14.33	0.05	5	c
62	3350		0.84	0.01	0.32	0.14	439	38	17	2.29	0.03	1	n
63	3360		0.52	0.01	0.24	0.24	434	46	46	1.00	0.04	2	n
64	3370	Permian:	0.15	0.03	0.04	0.25	---	27	167	0.16	0.43	20	f
65	3380	San Andres LS	0.26	0.03	0.45	0.34	427	173	131	1.32	0.06	12	n
66	3390		0.53	0.07	1.31	0.45	425	247	85	2.91	0.05	13	n
67	3397		12.77	1.04	27.95	0.69	420	219	5	40.51	0.04	8	n
68	3400		0.05	0.02	0.10	0.28	433	200	560	0.36	0.17	40	n
69	3410		3.70	0.55	15.38	0.70	420	416	19	21.97	0.03	15	n
70	3420		0.78	0.20	2.87	0.57	419	368	73	5.04	0.07	26	n
71	3430		0.20	0.03	0.33	0.42	431	165	210	0.79	0.08	15	n
72	3435		0.31	0.02	0.14	0.27	425	45	87	0.52	0.12	6	n
73	3465	Permian:	0.06	0.05	0.04	0.22	---	67	367	0.18	0.56	83	f
74	3495	Glorieta SS	0.07	0.02	0.03	0.25	---	43	357	0.12	0.40	29	f
75	3525		0.04	0.04	0.01	0.26	---	25	650	0.04	0.80	100	c

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Table I.4

ARIZONA GEOLOGICAL SURVEY

WELL NAME: #1 Alpine-Federal
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DEPTH (ft)	ACU/ FORMATION	TOC AND ROCK-EVAL DATA				INTERPRETIVE RATIOS				NOTES	
		TOC	S1	S2	S3	TMAX	HI	OI \$2/S3	PI \$1/TOC	Check	Problems
3555	Permian: Supai Group Corduroy fm	0.04	0.07	0.01	0.25	---	25	625	0.04	0.88	175
3585		0.07	0.08	0.02	0.24	---	29	343	0.08	0.80	114
3615		0.12	0.04	0.04	0.28	---	33	233	0.14	0.50	33
3645		0.16	0.01	0.02	0.42	---	13	263	0.05	0.33	6
3690		0.14	0.00	0.00	0.33	---	0	236	0.00	---	0
3755		0.08	0.05	0.04	0.30	---	50	375	0.13	0.56	63
3785		0.06	0.01	0.01	0.20	---	17	333	0.05	0.50	17
3795		0.07	0.01	0.01	0.17	---	14	243	0.06	0.50	14
3805		0.03	0.01	0.02	0.14	---	67	467	0.14	0.33	33
3815		0.05	0.02	0.02	0.21	---	40	420	0.10	0.50	40
3825		0.02	0.02	0.00	0.18	---	0	900	0.00	1.00	100
3835		0.02	0.00	0.06	0.00	---	300	0	---	0.00	0
3845		0.16	0.00	0.03	0.11	---	19	69	0.27	0.00	0
3865		0.03	0.01	0.01	0.05	---	33	167	0.20	0.50	33
3878		3.22	0.96	12.29	0.63	436	382	20	19.51	0.07	30
3885		0.15	0.01	0.06	0.13	435	40	87	0.46	0.14	7
3905		0.15	0.04	0.02	0.23	---	13	153	0.09	0.67	27
3915		1.03	0.45	3.69	0.27	431	358	26	13.67	0.11	44
3925		0.19	0.03	0.09	0.19	431	47	100	0.47	0.25	16
3945		0.02	0.03	0.01	0.15	---	50	750	0.07	0.75	150
3965		0.09	0.07	0.22	0.11	438	244	122	2.00	0.24	78
3975		7.21	2.68	25.50	0.66	436	354	9	38.64	0.10	37
3975		1.55	0.56	5.81	0.64	434	375	41	9.08	0.09	36
3985		0.01	0.01	0.02	0.33	---	200	3300	0.06	0.33	100
4005		0.02	0.01	0.01	0.21	---	50	1050	0.05	0.50	50

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Table I.5

ARIZONA GEOLOGICAL SURVEY

WELL NAME: #1 Alpine-Federal
ATTN: Steven Rauzi

DEPTH (ft)	ACR/ FORMATION	TOC AND ROCK-EVAL DATA				INTERPRETIVE RATIOS				NOTES	
		TOC	S1	S2	S3	TMAX	HI	OL \$2/S3	PI	\$I/TOC	Check Program
4015		0.20	0.02	0.01	0.14	---	5	70	0.07	0.67	10
4025		0.14	0.12	0.55	0.12	435	393	86	4.58	0.18	86
4028		3.54	2.43	18.30	0.50	435	517	14	36.60	0.12	69
4045		0.10	0.02	0.02	0.20	---	20	200	0.10	0.50	20
4060		0.18	0.11	0.59	0.20	434	328	111	2.95	0.16	61
4065		1.40	0.66	4.49	0.45	437	321	32	9.98	0.13	47
4085		0.02	0.03	0.02	0.19	---	100	950	0.11	0.60	150
4089		0.15	0.02	0.12	0.19	439	80	127	0.63	0.14	13
4105		0.02	0.01	0.01	0.20	---	50	1000	0.05	0.50	50
4115		0.04	0.01	0.01	0.08	---	25	200	0.13	0.50	25
4125		1.86	0.31	5.70	0.30	431	306	16	19.00	0.05	17
4130		1.65	0.23	4.48	0.34	433	272	21	13.18	0.05	14
4145		2.26	0.28	6.02	0.27	435	266	12	22.30	0.04	12
4165		0.08	0.03	0.05	0.18	---	63	225	0.28	0.38	38
4185		0.11	0.02	0.17	0.17	---	155	155	1.00	0.11	18
4205		0.11	0.01	0.01	0.13	---	9	118	0.08	0.50	9
4225	Permian:	0.22	0.03	0.06	0.24	---	27	109	0.25	0.33	14
4230	Supai group	0.12	0.06	0.15	0.22	439	125	183	0.68	0.29	50
4235	Fort Apache mbr	4.25	2.26	16.66	0.56	431	392	13	29.75	0.12	53
4245		0.07	0.03	0.05	0.41	435	71	586	0.12	0.38	43
4255		0.24	0.02	0.07	0.26	---	29	108	0.27	0.22	8
4260		0.16	0.02	0.06	0.28	---	38	175	0.21	0.25	13
4265		0.10	0.01	0.08	0.21	---	80	210	0.38	0.11	10
4295		0.14	0.00	0.01	0.20	---	7	143	0.05	0.00	0
4325		0.87	0.10	0.11	0.25	362	13	29	0.44	0.48	11

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Table 1.6

ARIZONA GEOLOGICAL SURVEY													
WELL NAME: #1 Alpine-Federal ATTN: Steven Rauzi													
DEPTH (ft)	ACR/ FORMATION	TOC AND ROCK-EVAL DATA				INTERPRETIVE RATIOS				NOTES			
		TOC	S1	S2	S3	TMAX	HI	OI	S2/S1	PI	S1/TOC	Check	Program
126	4355	0.12	0.01	0.03	0.27	---	25	225	0.11	0.25	8	c	f
127	4355	0.13	0.08	0.03	0.17	---	23	131	0.18	0.73	62		f
128	4375	0.22	0.11	0.03	0.17	---	14	77	0.18	0.79	50		f
129	4385	0.51	0.14	0.06	0.17	---	12	33	0.35	0.70	27		f
130	4385	0.27	0.07	0.02	0.20	---	7	74	0.10	0.78	26		f
131	4395	0.25	0.08	0.04	0.16	---	16	64	0.25	0.67	32		f
132	4397	0.14	0.07	0.05	0.20	---	36	143	0.25	0.58	50		f
133	4402	0.18	0.02	0.12	0.12	520	67	67	1.00	0.14	11		n
134	4405	0.23	0.03	0.06	0.16	---	26	70	0.38	0.33	13		f
135	4409	0.12	0.02	0.05	0.09	---	42	75	0.56	0.29	17		f
136	4413	0.03	0.05	0.07	0.20	---	233	667	0.35	0.42	167		f
137	4415 Permian:	0.04	0.01	0.04	0.07	---	100	175	0.57	0.20	25		f
138	4425 Supai group	0.24	0.02	0.44	0.20	484	183	83	2.20	0.04	8		n
139	4428 Amos Wash fm	0.13	0.11	0.10	0.15	351	77	115	0.67	0.52	85		LS2
140	4435 (Big A Butte mbr)	0.13	0.01	0.07	0.14	---	54	108	0.50	0.12	8		f
141	4445	0.16	0.01	0.02	0.20	---	13	125	0.10	0.33	6		f
142	4455	0.17	0.00	0.18	0.19	---	106	112	0.95	0.00	0		f
143	4485	0.11	0.04	0.06	0.53	---	55	482	0.11	0.40	36		f
144	4505 Total Depth	0.11											

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* Tmax data not reliable due to low S2 values
 TOC = weight percent organic carbon
 S1, S2 = mg hydrocarbons/g rock
 S3 = mg carbon dioxide/g rock
 Tmax = Degree C

NOTES:

Check
 c = sample analysis confirmed
 Pyrogram
 n = normal
 f = flat (no peak)
 LS2 = low temperature S2 peak

HI = S2*100/TOC
 OI = S3*100/TOC
 PI = S1/(S1+S2)
 S1/TOC = S1*100/TOC

Phone (713) 540-6050

Humble, Texas 77347

P. O. Box 789

Humble Geochemical Services

TABLE II

ARIZONA GEOLOGICAL SURVEY

WELL NAME: #1 Alpine Federal
ATTN: Steven Rauzi

SAMPLE TYPE	DEPTH (ft)	TOC	TMAX	S2	HI	Kerogen Type	Mean Ro	Remarks
core	3305	6.59	449	3.59	54	C(100)	0.65	Picked Coal; Good but immature gas source
core	3340.0	8.58	444	8.60	100	C(100)	0.62	Picked Coal; Good but immature gas source
core	3878.0	3.22	436	12.29	382	Am(95) C(5)	0.42	Yellow-Orange flour. Exc. Excellent but immature oil source
core	4235.0	4.25	431	16.66	392	Am(97) C(3)	0.40	Excellent potential oil source; immature

PAGE 1 OF 1

HGS Project 94-64

Am= Amorphous C = Coaly

Table III

ARIZONA GEOLOGICAL SURVEY 1 ALPINE-FEDERAL			
HGS DERIVED KINETIC PARAMETERS Five heating rates: 1, 5, 10, 15, and 30 C/min (in duplicate)			
Sample ID.	Corduroy Fm. Permian Supai Group 3,975 feet		
HGS Sample ID.	94A-64-97		
Kinetics Output File Name:	SUPALOUT		
Arrhenius factor (/sec)	4.0475E+13		
Discrete Model Results	Percent of Reaction		
Activation Energy (kcal/mole)			
40			
41			
42			
43			
44			
45			
46	0.29		
47	0.51		
48			
49			
50			
51			
52			
53	79.51		
54	0.81		
55	12.14		
56			
57	6.74		
58			
59			
60			
61			
62			
63			
64			
65			
66			
67			
68			
69			
70			
Approximate Error - S (%Ea)	1.74		
GAUSSIAN RESULTS:			
n = 1			
A (/sec)	5.1491E+13		
Ea (cal/mole)	53623		
S (%Ea)	1.57		
Best Reaction Order (n)	1.20		
3 Parameter Narrow Profile Results:			
A (/sec)	na		
Ea (cal/mole)	na		
(1-x) exponent (m)	na		

AGS #1 ALPINE-FEDERAL ORGANIC FACIES PLOT

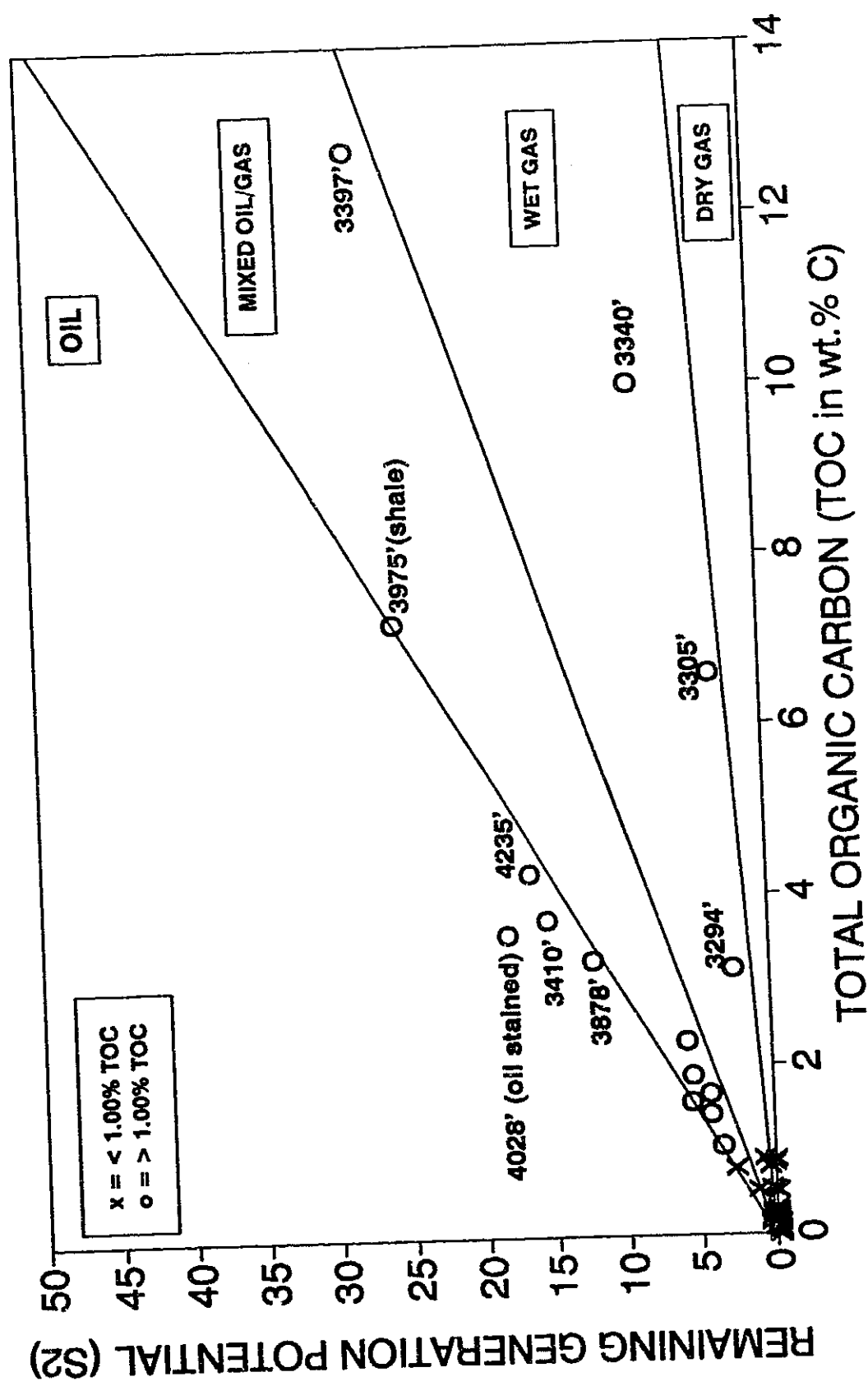


Figure 1
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

ARIZONA GEOLOGICAL SURVEY
NEW MEXICO STATE UNIVERSITY
#1 ALPINE-FEDERAL

KEROGEN TYPE PLOT

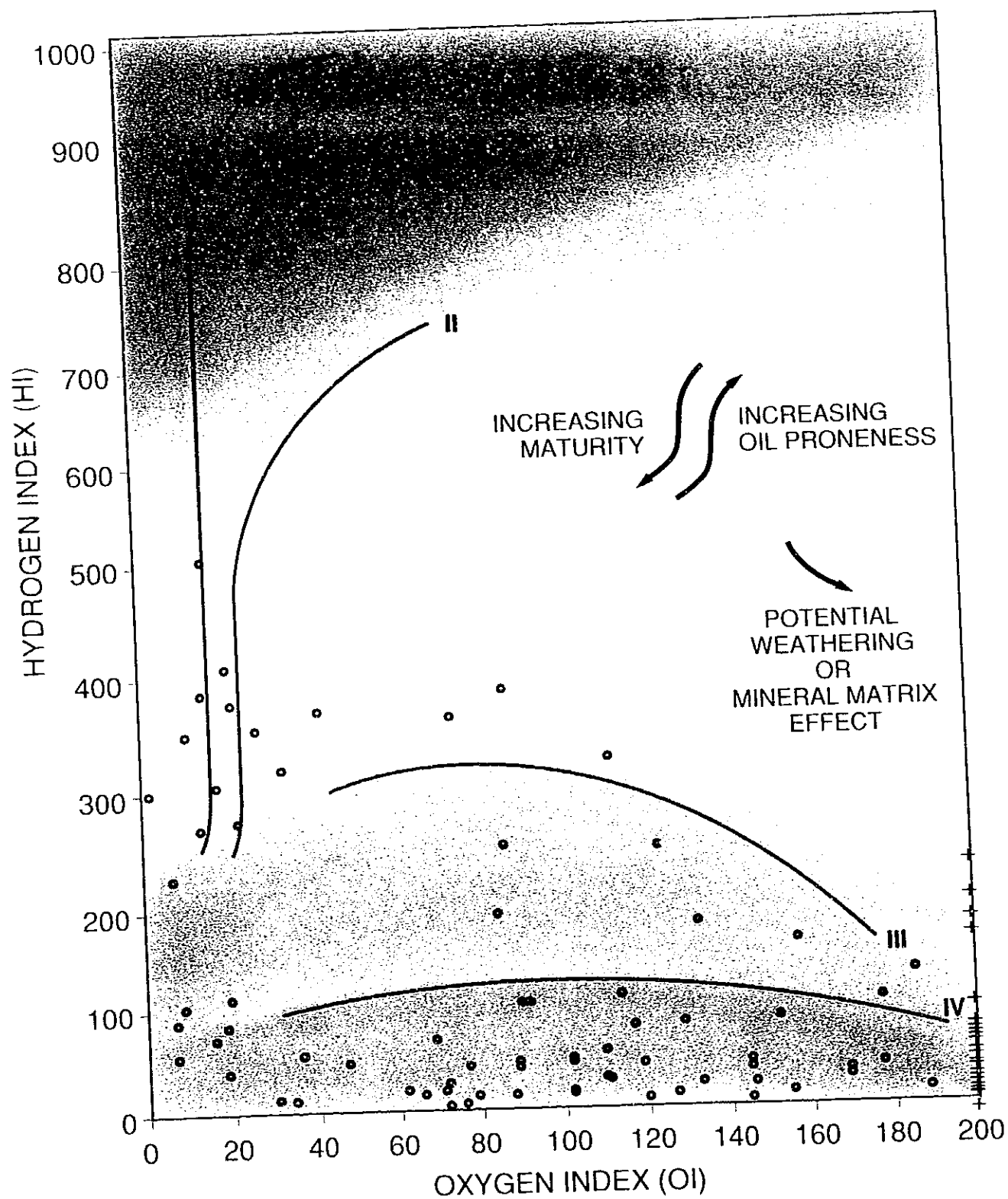


Figure 2

ARIZONA GEOLOGICAL SURVEY
NEW MEXICO STATE UNIVERSITY
#1 ALPINE-FEDERAL

KEROGEN TYPE PLOT

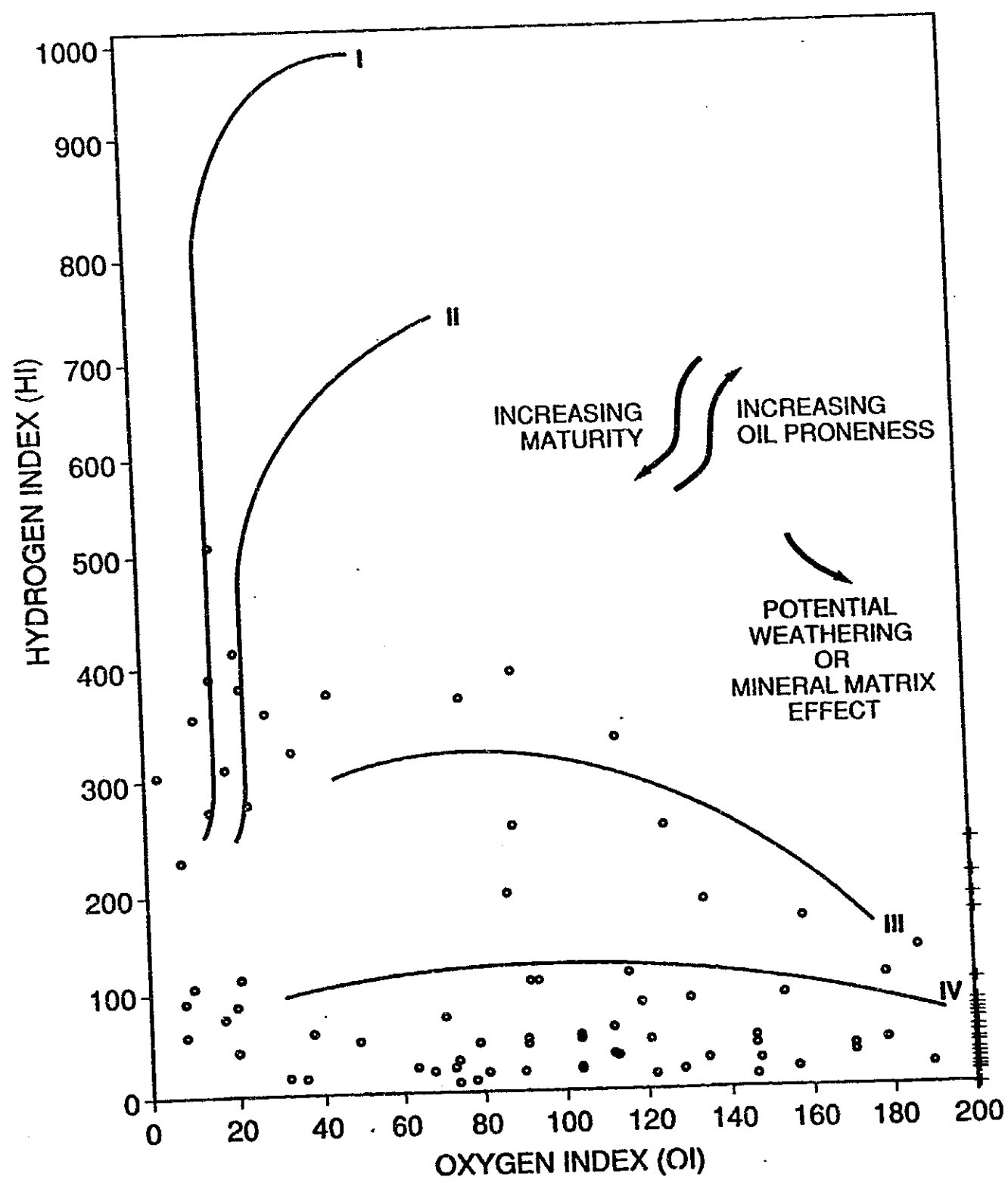


Figure 2

ARIZONA GEOLOGICAL SURVEY
NEW MEXICO STATE UNIVERSITY
#1 ALPINE-FEDERAL

KEROGEN TYPE AND MATURITY PLOT

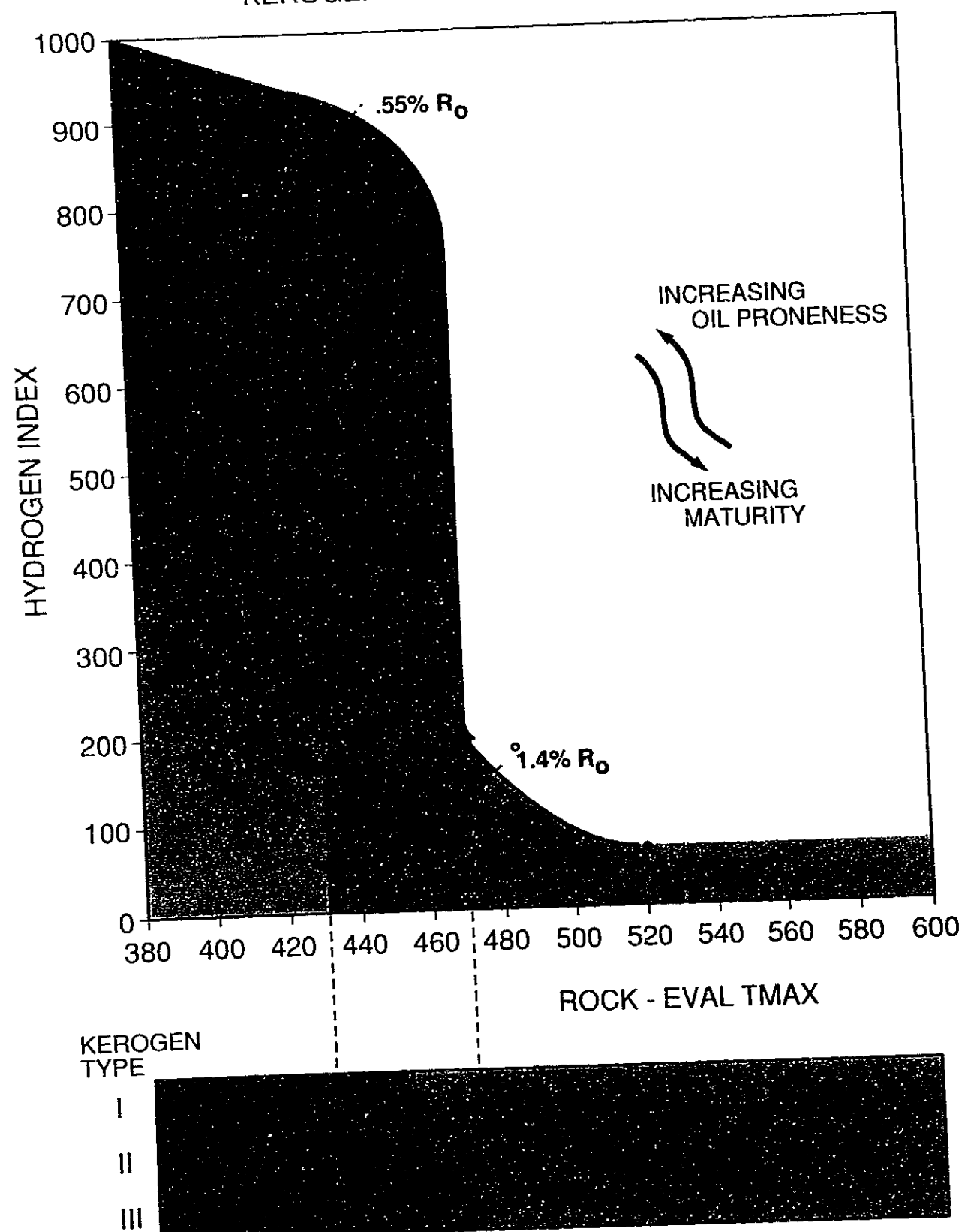
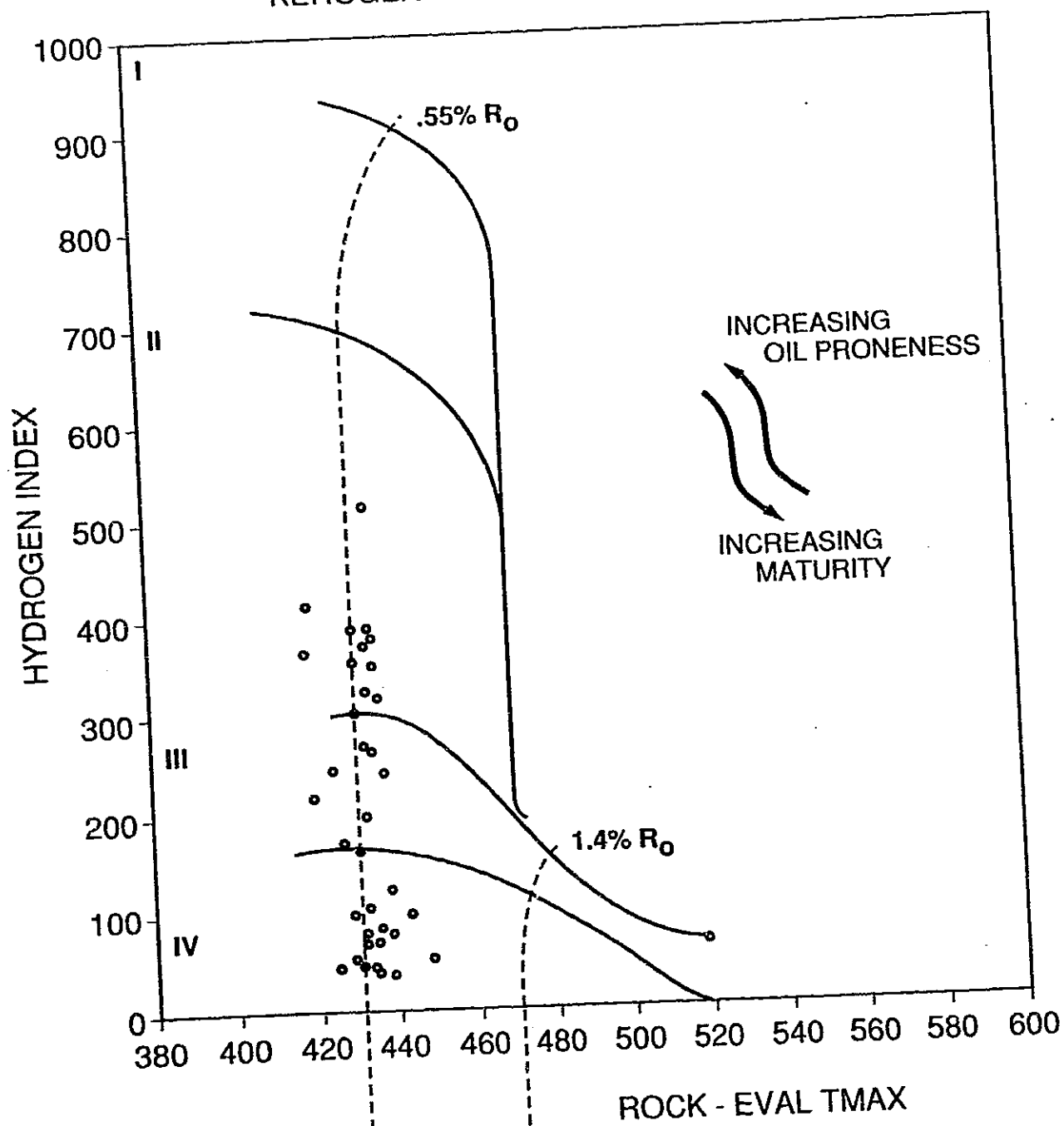


Figure 3

ARIZONA GEOLOGICAL SURVEY
NEW MEXICO STATE UNIVERSITY
#1 ALPINE-FEDERAL
KEROGEN TYPE AND MATURITY PLOT



KEROGEN
TYPE

I	IMMATURE	OIL	GAS
II	IMMATURE	OIL	GAS
III	IMMATURE	OIL	GAS

Figure 3

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 2 GHMB6.7.1

THERMAL EXTRACT (S1) / GC #1 ALPINE FEDERAL

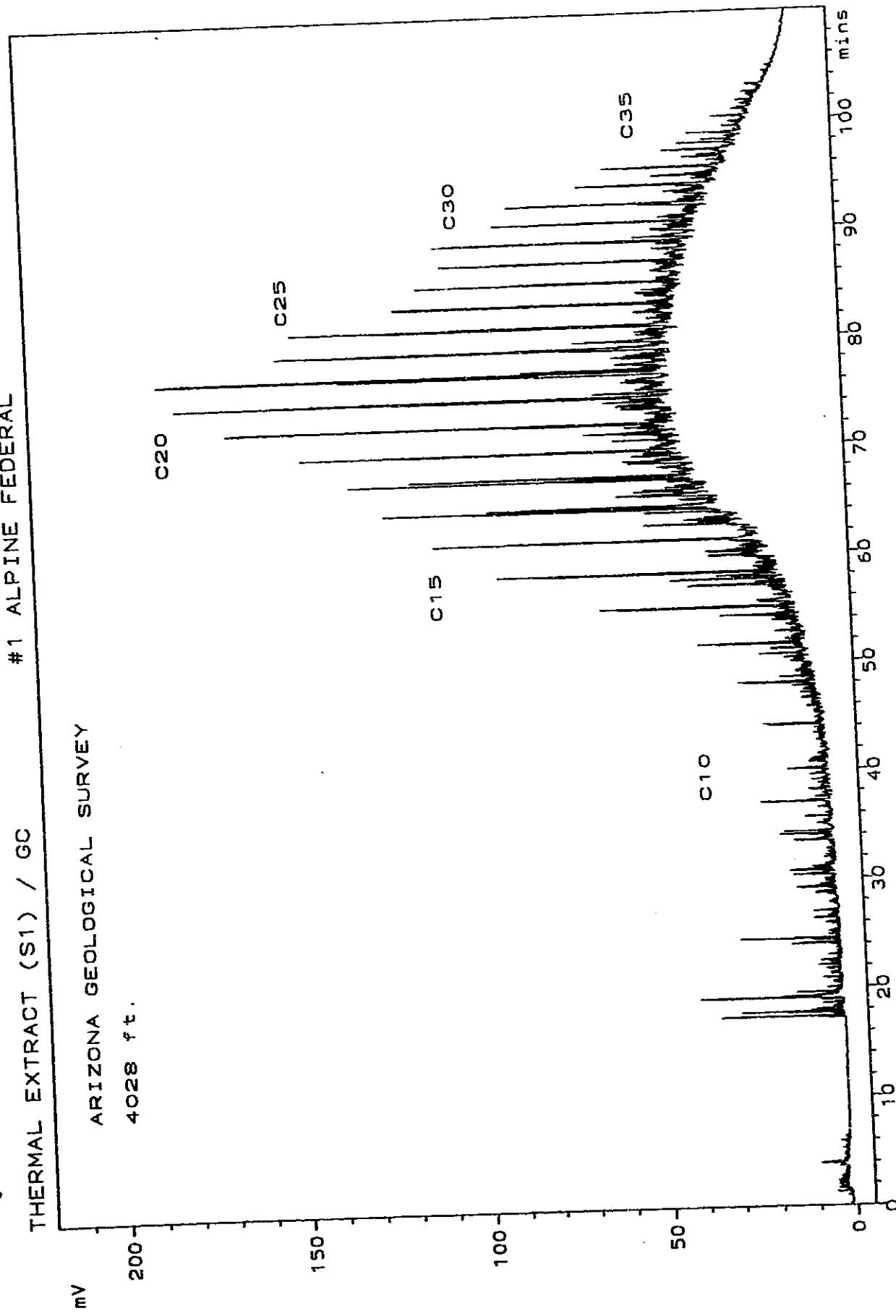


Figure 4.a
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 2 GHMB6.10.1

#1 ALPINE FEDERAL

THERMAL EXTRACT (S1) / GC

ARIZONA GEOLOGICAL SURVEY

3305 ft.

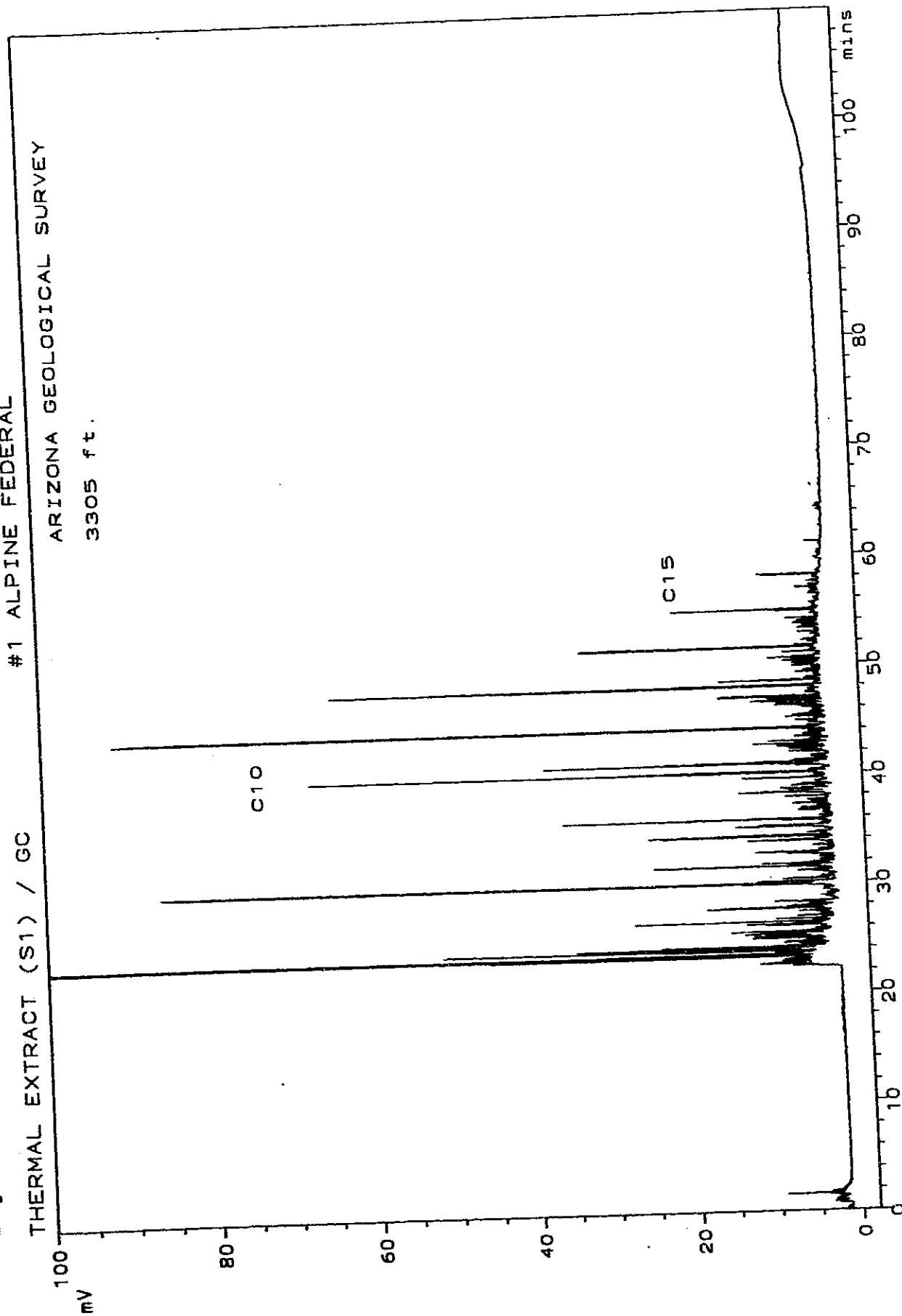


Figure 4b
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 2 GHMB6.15.1

THERMAL EXTRACT (S1) / GC #1 ALPINE FEDERAL

ARIZONA GEOLOGICAL SURVEY

3340 ft.

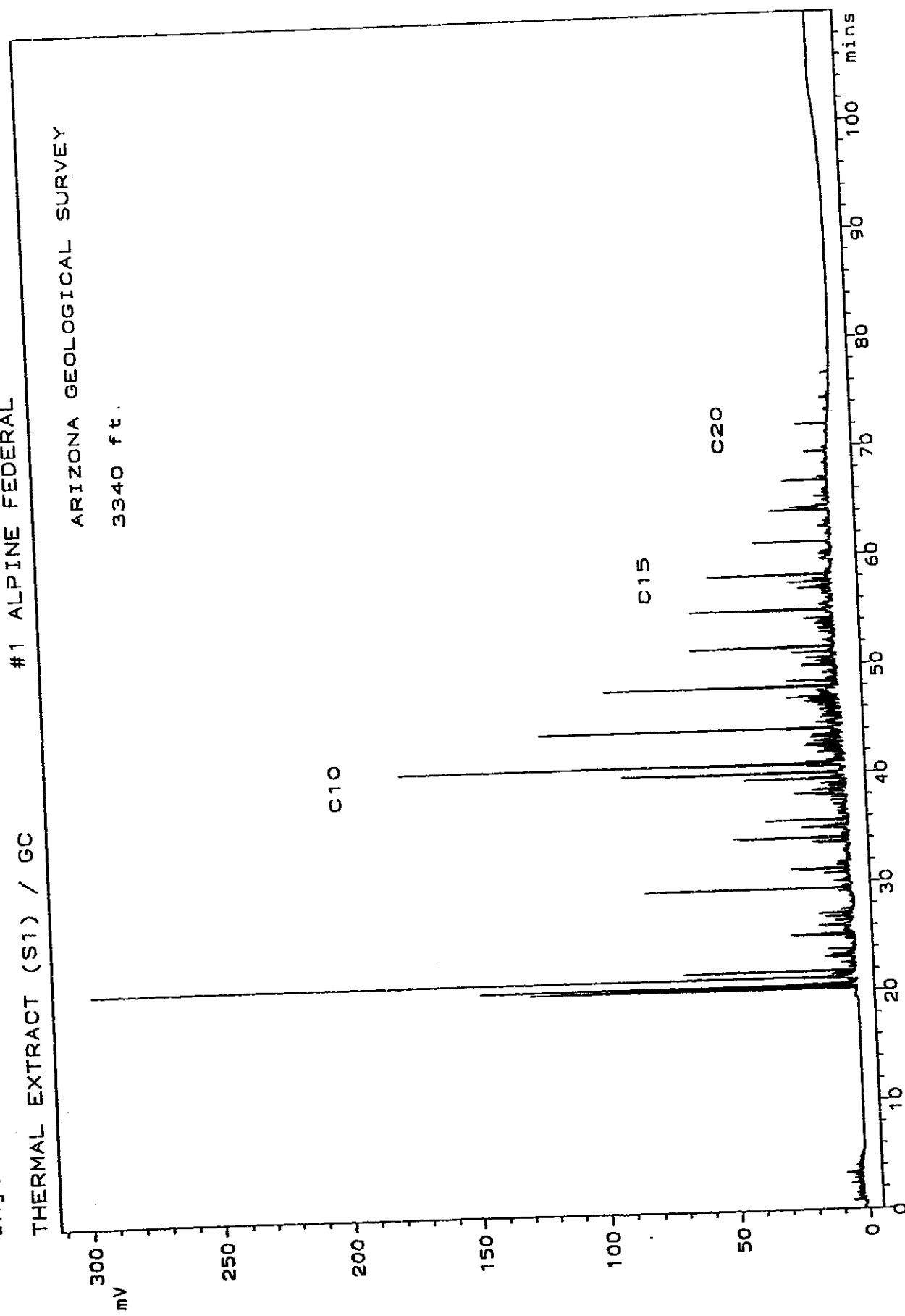


Figure 4.c
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 2 GHMB6,16,1

#1 ALPINE FEDERAL

THERMAL EXTRACT (S1) / GC

ARIZONA GEOLOGICAL SURVEY
3397 ft.

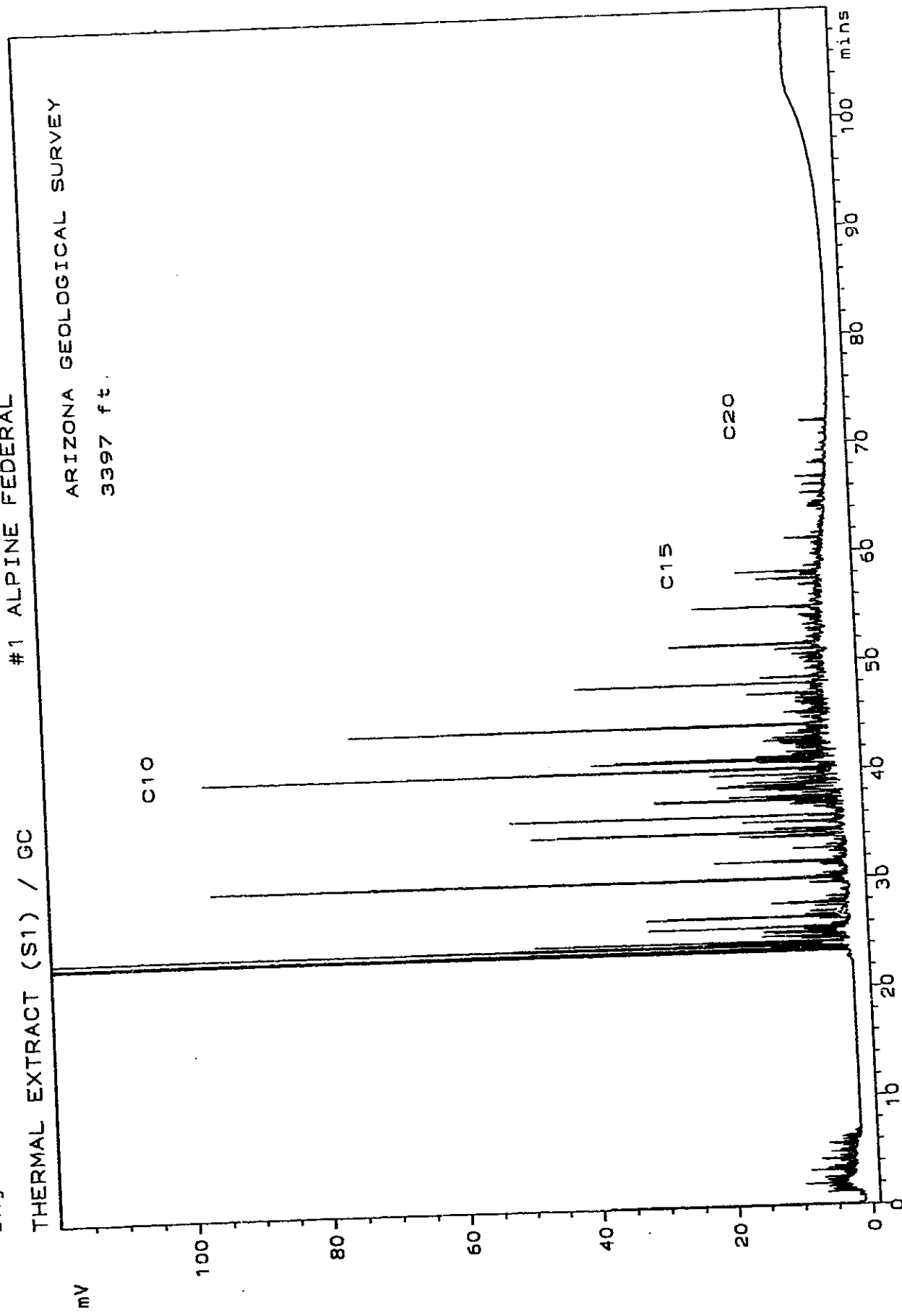


Figure 4d
Humble Geochemical Services P.O. Box 789 Humble, TX 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 2 GHMB6,13,1

THERMAL EXTRACT (S1) / GC

#1 ALPINE FEDERAL

ARIZONA GEOLOGICAL SURVEY

3410 ft.

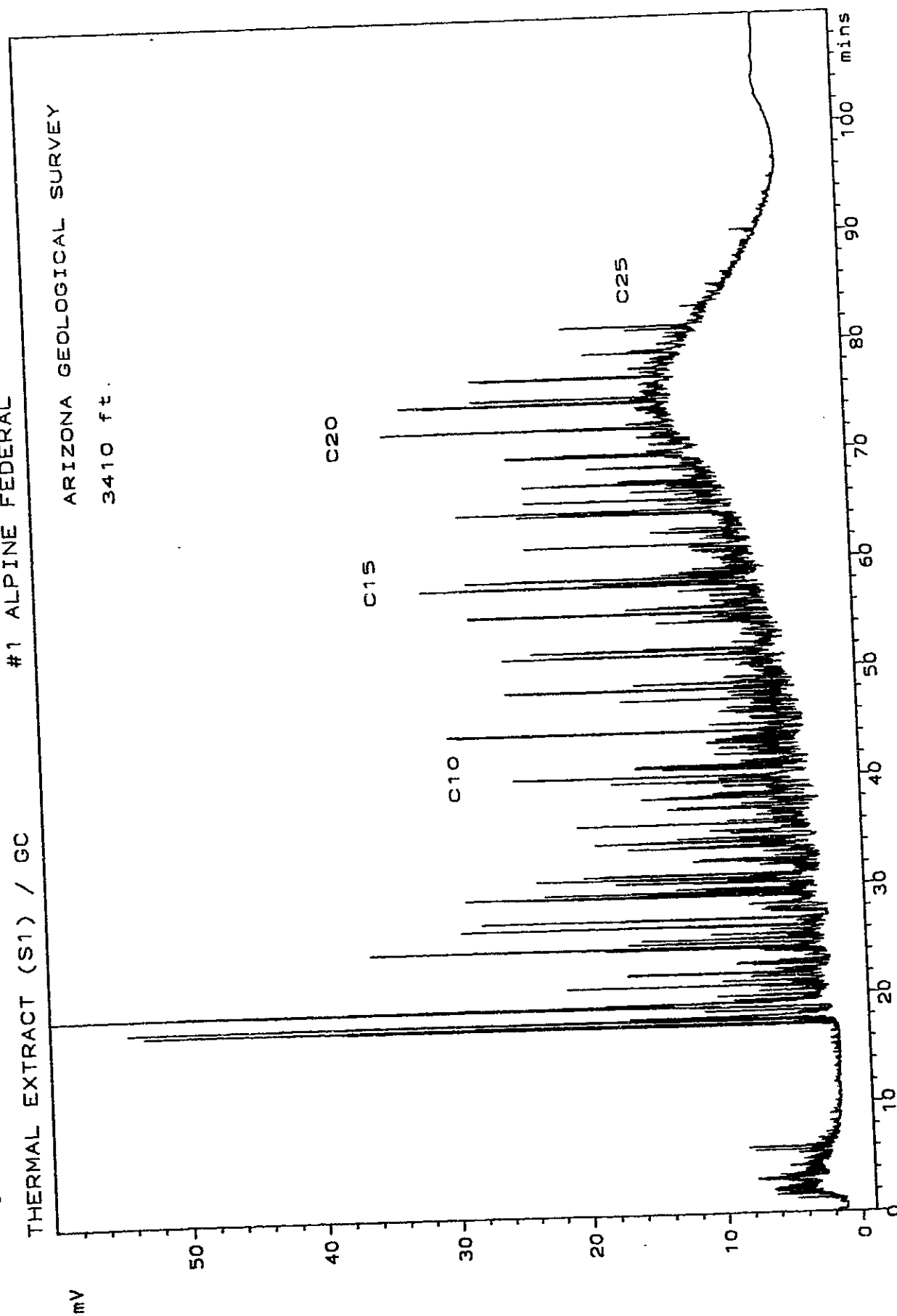


Figure 4c
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 2 GHMB6,19,1

THERMAL EXTRACT (S1) / GC #1 ALPINE FEDERAL

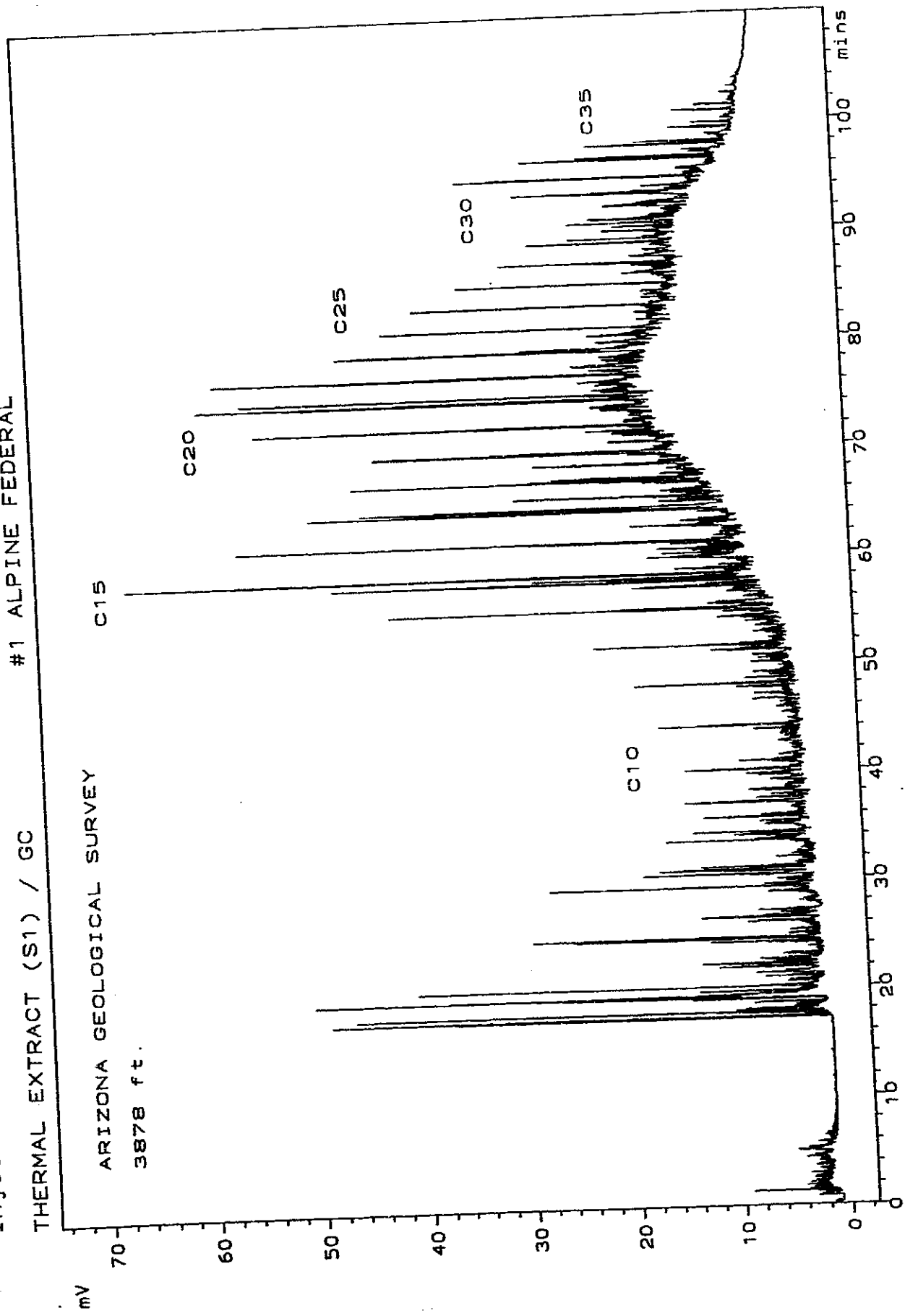


Figure 4f
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 2 GHMB6.14.1

THERMAL EXTRACT (S1) / GC

#1 ALPINE FEDERAL

ARIZONA GEOLOGICAL SURVEY

3975 ft.

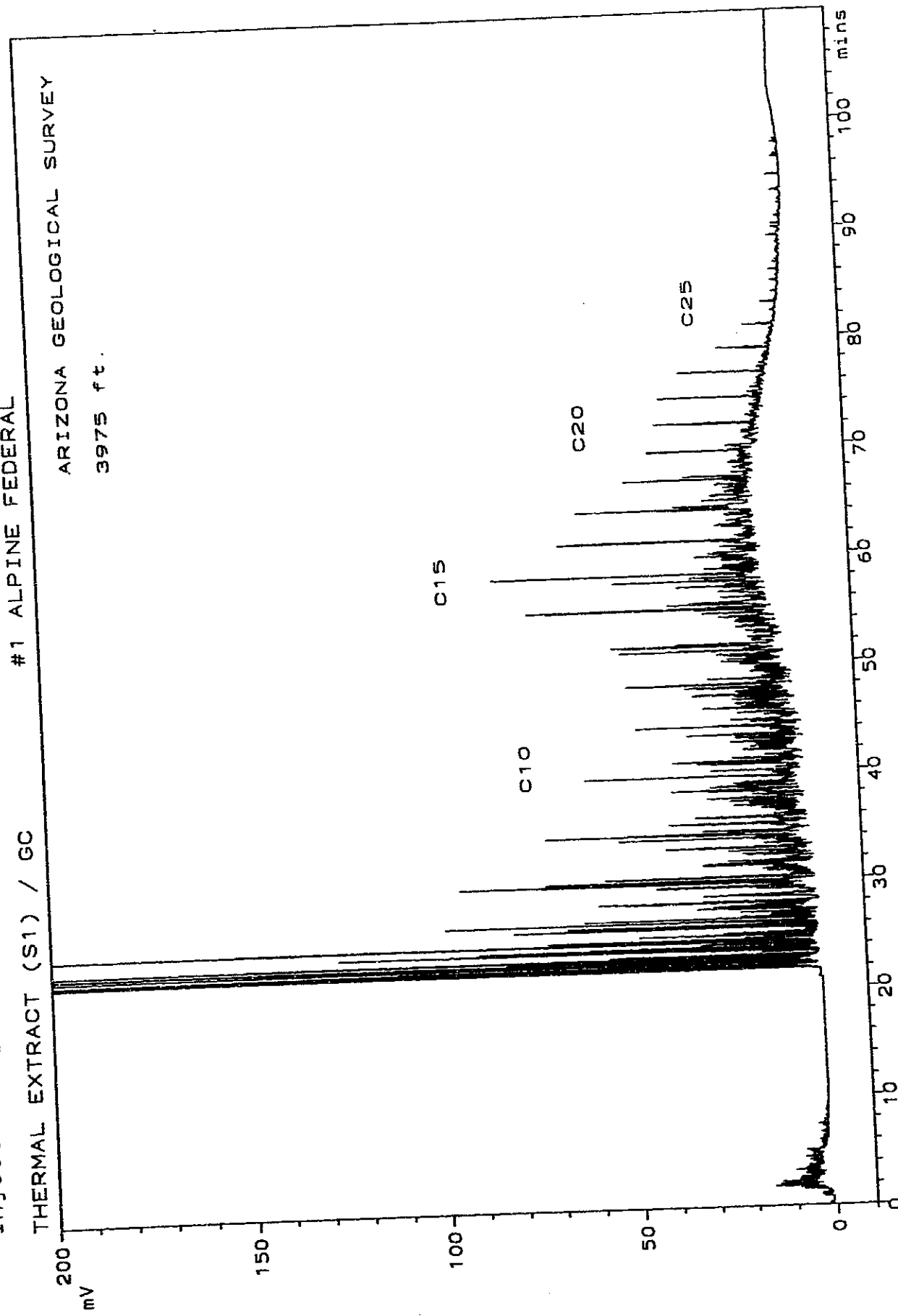


Figure 4g
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 2 GHMB6,18,1

THERMAL EXTRACT (S1) / GC

#1 ALPINE FEDERAL

ARIZONA GEOLOGICAL SURVEY

4235 ft.

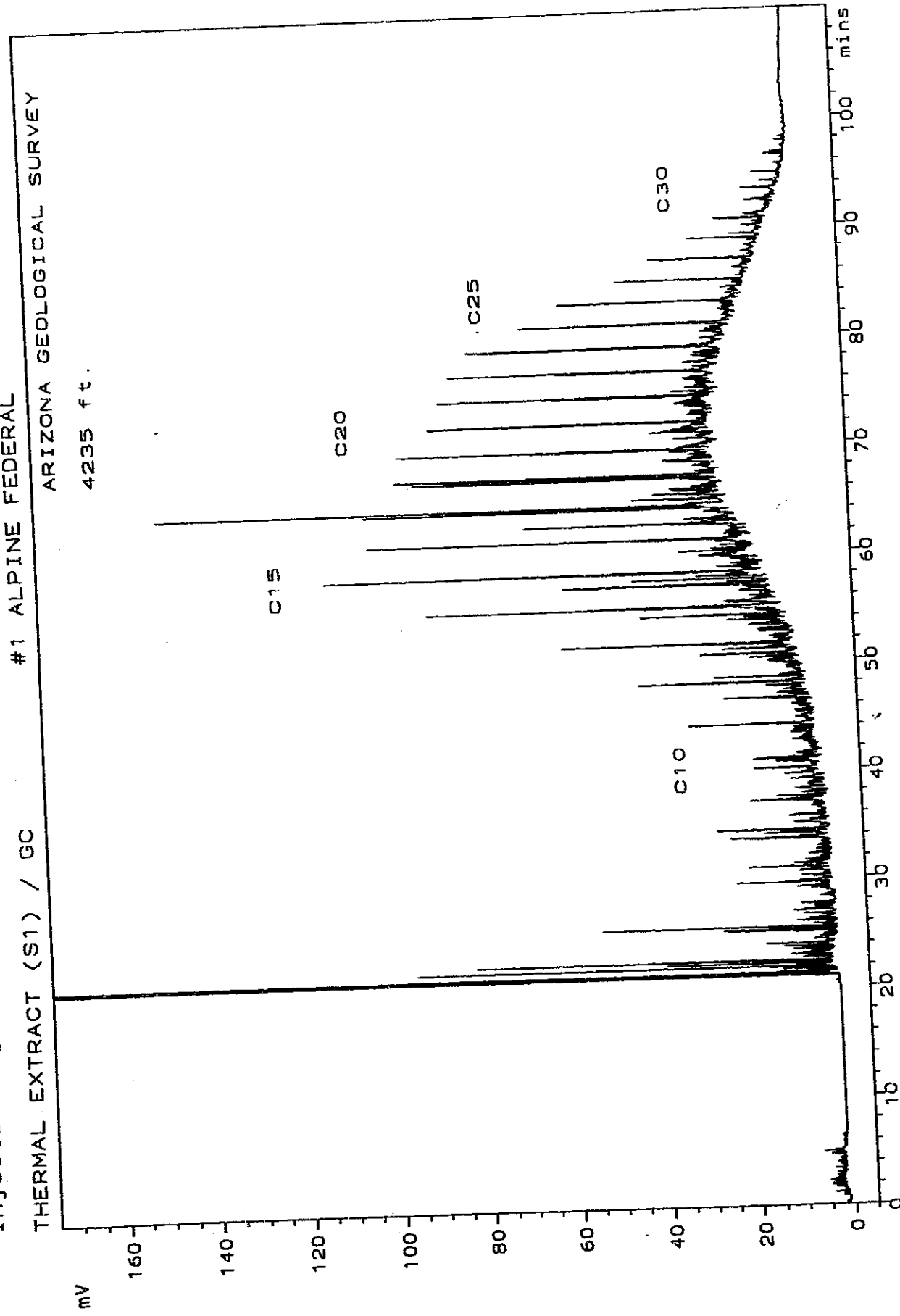


Figure 4h
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

DEPOSITIONAL ENVIRONMENT & MATURITY **USING TE/GC RATIOS**

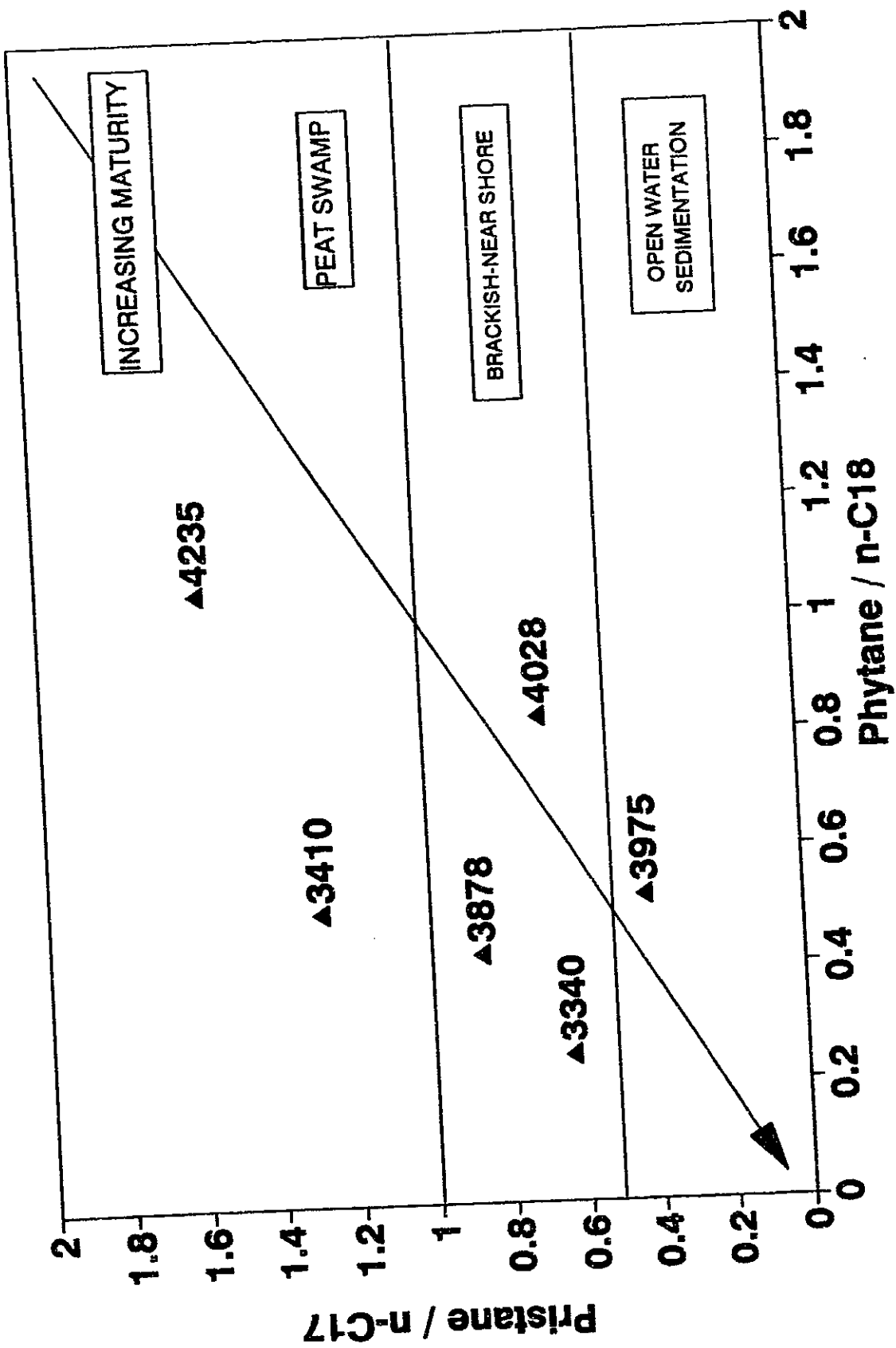


Figure 5
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 1 GHMA6.7.1

PYROLYSIS (S2) / GC #1 ALPINE FEDERAL

ARIZONA GEOLOGICAL SURVEY

4028 ft.

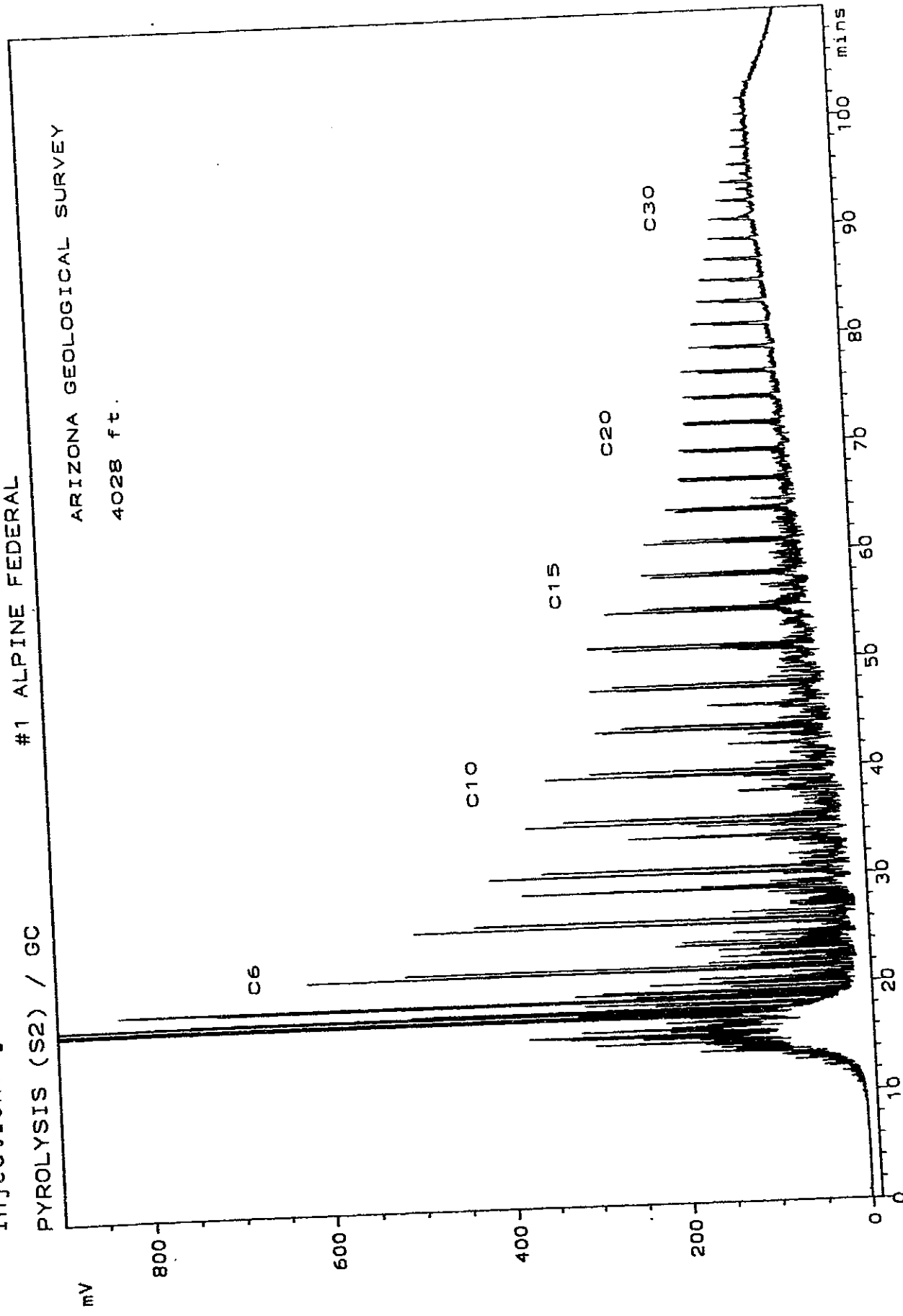


Figure 6.a
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 1 GHMA6,10,1

#1 ALPINE FEDERAL

PYROLYSIS (S2) / GC

ARIZONA GEOLOGICAL SURVEY

3305 ft.

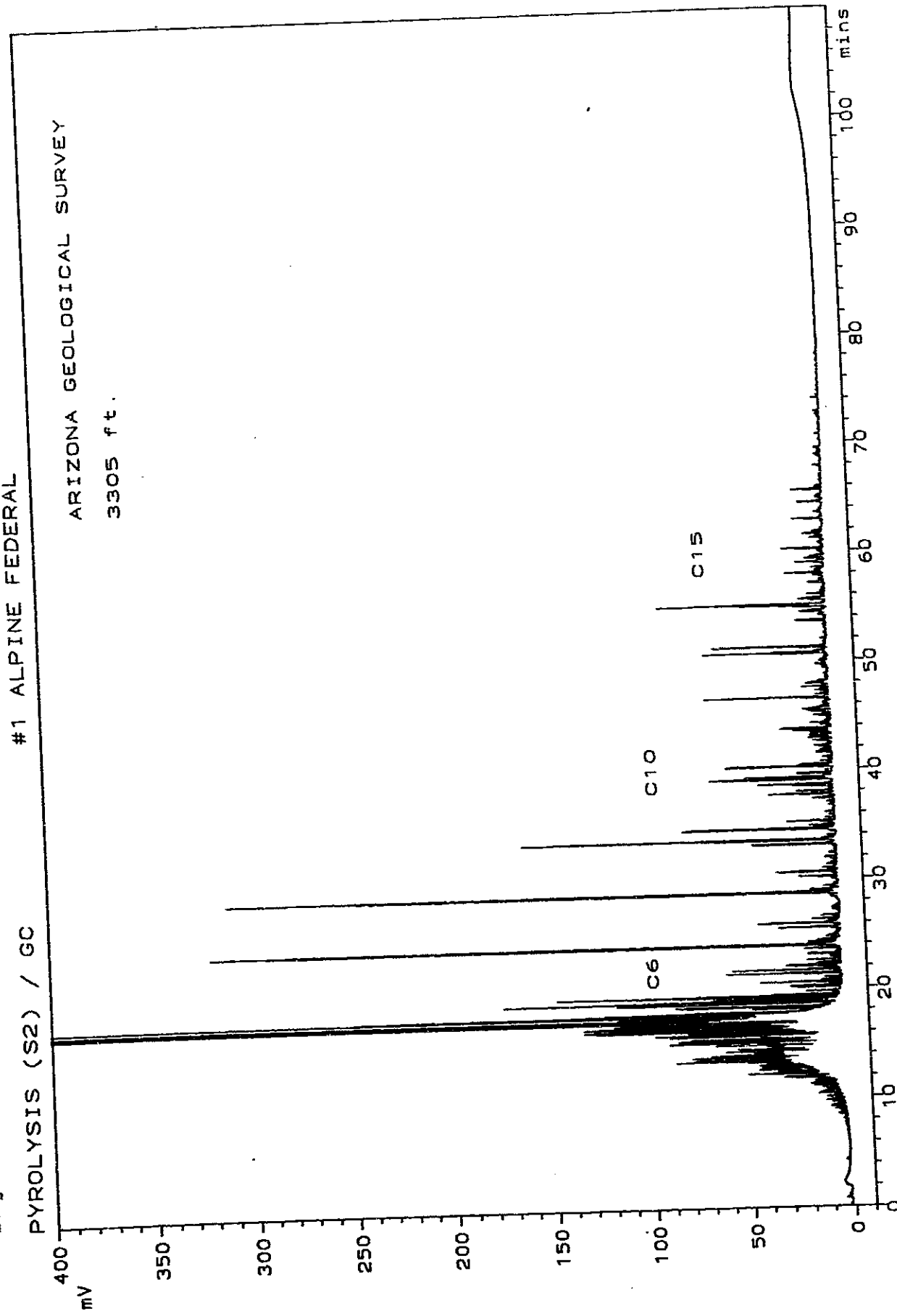


Figure 6.b
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 1 GHMA6,15.1

#1 ALPINE FEDERAL

PYROLYSIS (S2) / GC

ARIZONA GEOLOGICAL SURVEY

3340 ft.

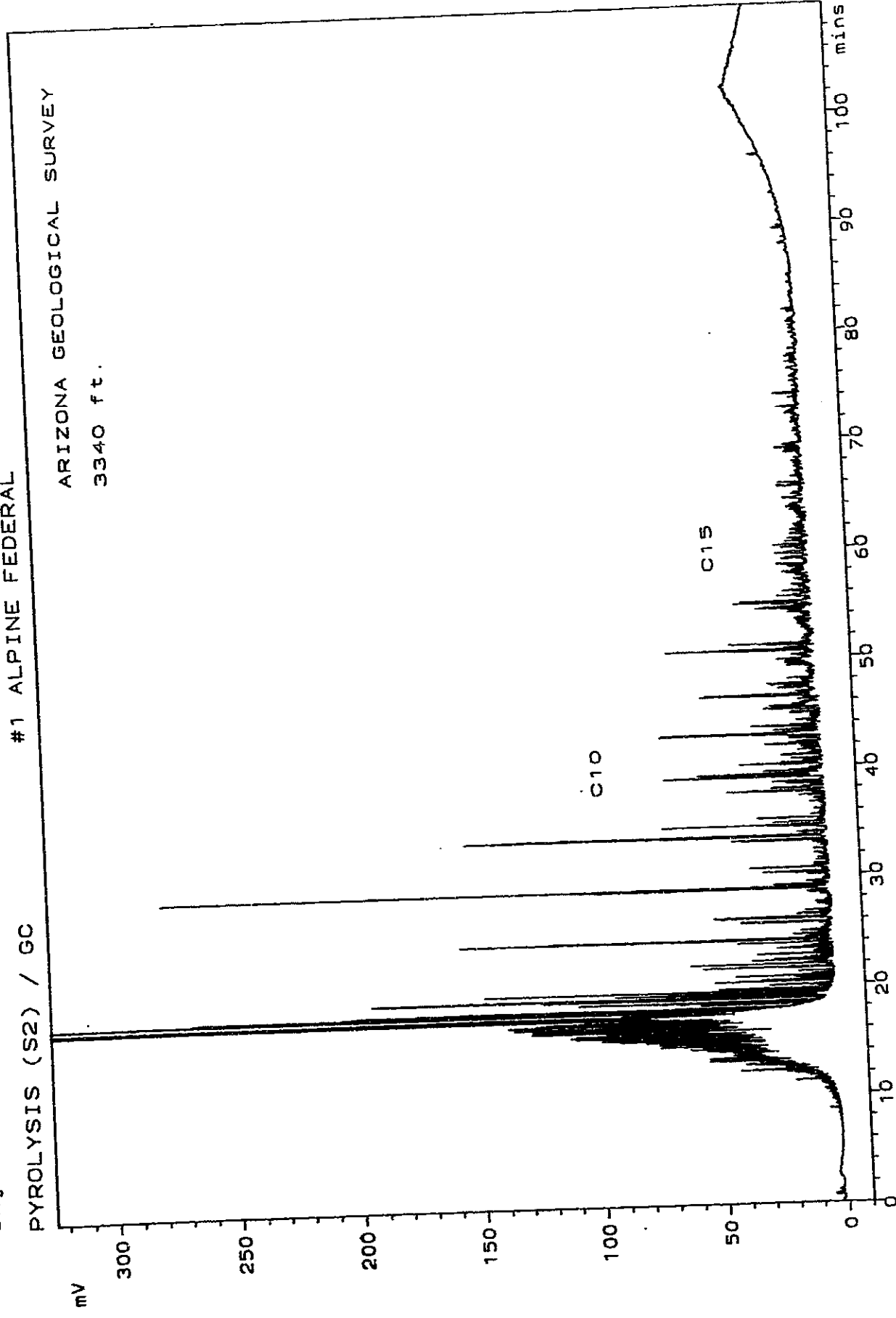


Figure 6.c
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 1 GHMA10.2,1

PYROLYSIS (S2) / GC #1 ALPINE FEDERAL

ARIZONA GEOLOGICAL SURVEY

3397 ft.

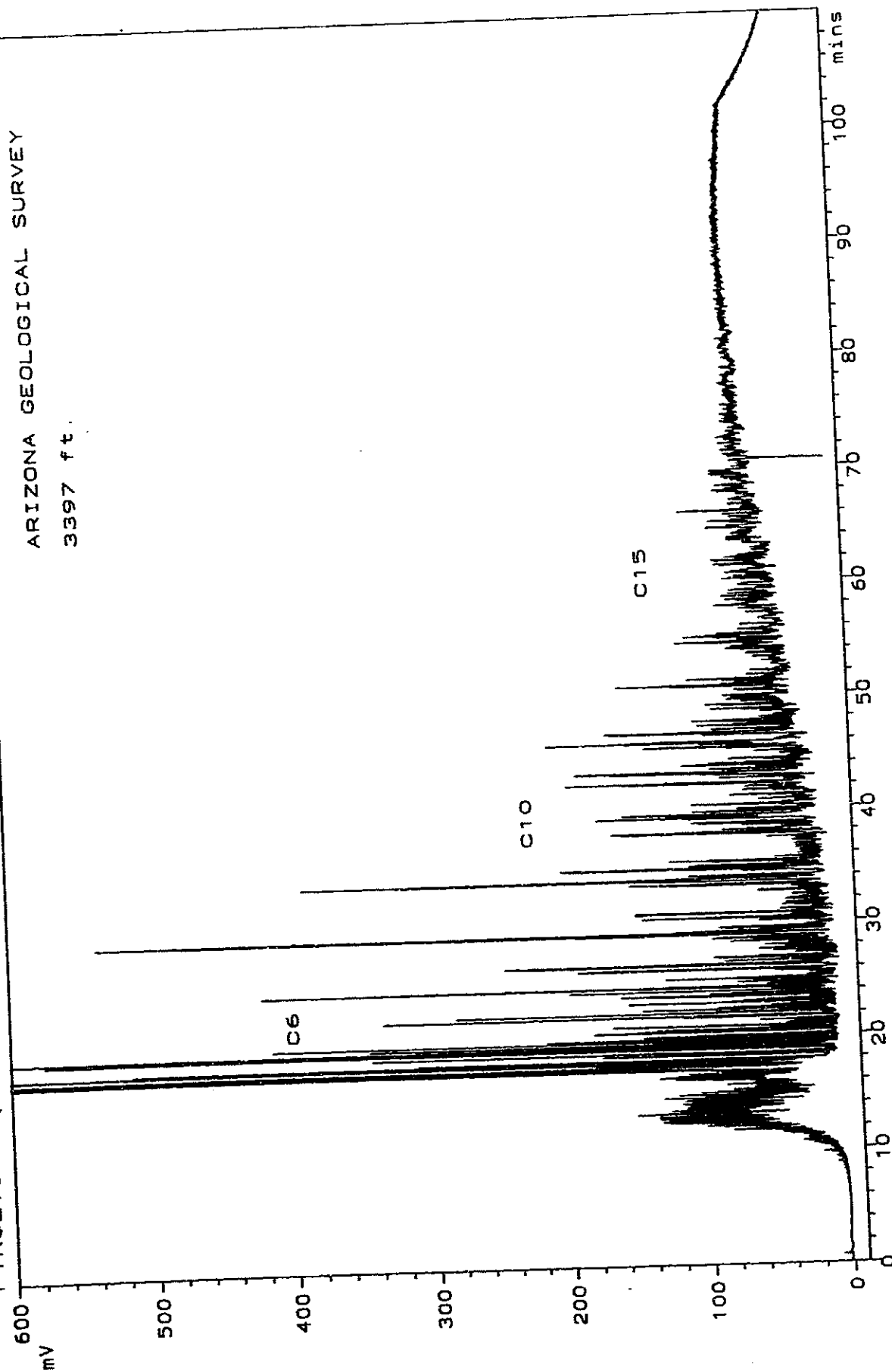


Figure 6.d
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 1 GHMA6.13.1

#1 ALPINE FEDERAL

PYROLYSIS (S2) / GC

ARIZONA GEOLOGICAL SURVEY

3410 ft.

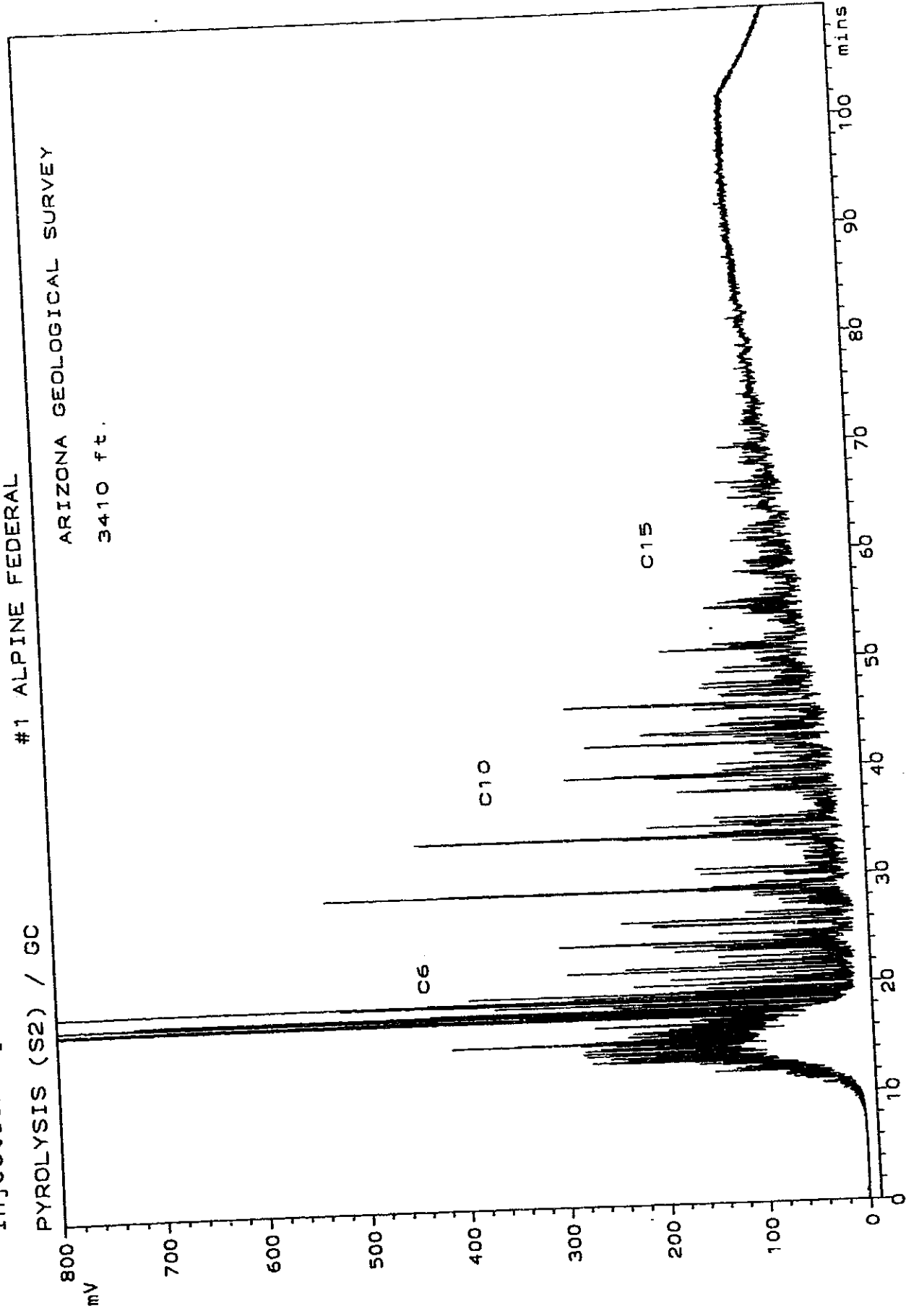


Figure 6.e
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 1 GHMA6,19,1

#1 ALPINE FEDERAL

PYROLYSIS (S2) / GC

ARIZONA GEOLOGICAL SURVEY
3878 ft.

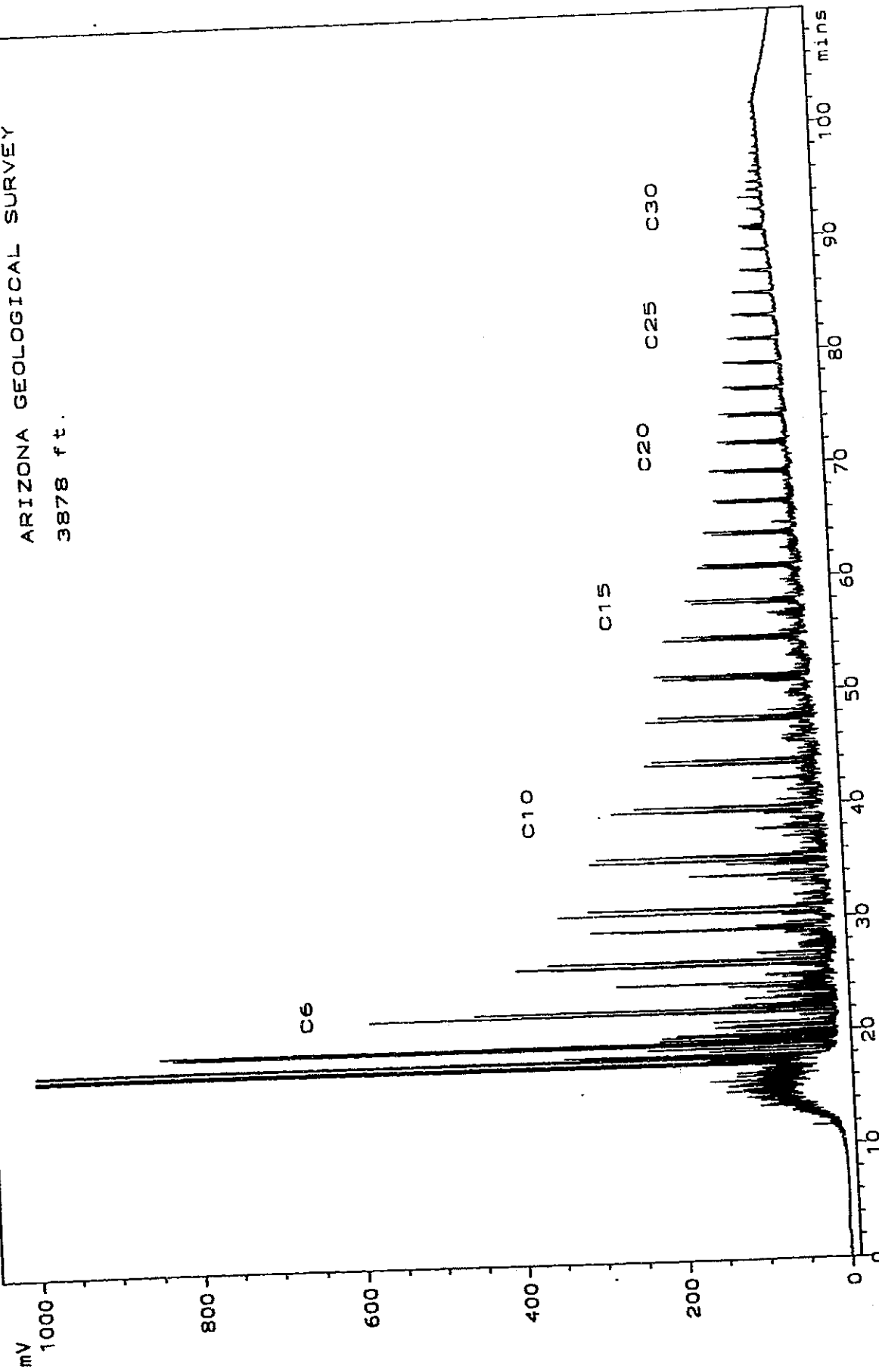


Figure 6.f
Humble Geochemical Services P.O. Box 789 Humble, TX 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 1 GHMA6,14,1

#1 ALPINE FEDERAL

PYROLYSIS (S2) / GC

ARIZONA GEOLOGICAL SURVEY

3975 ft.

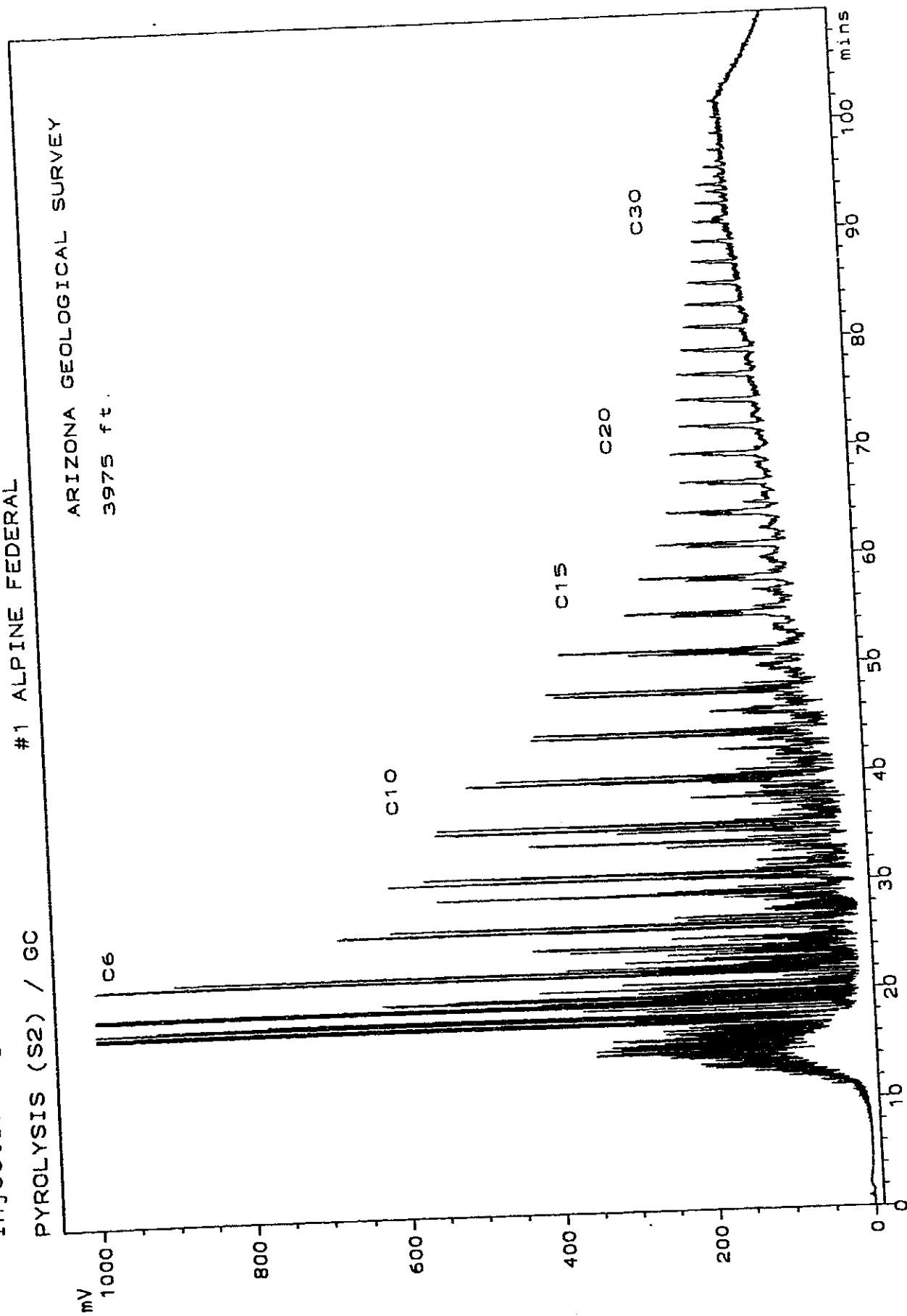


Figure 6.g
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

HUMBLE GEOCHEMICAL SERVICES: GC DATA SYSTEM

Injection: [DEFPROJ] 1 GHMA6,18,1

#1 ALPINE FEDERAL

PYROLYSIS (S2) / GC

ARIZONA GEOLOGICAL SURVEY

4235 ft.

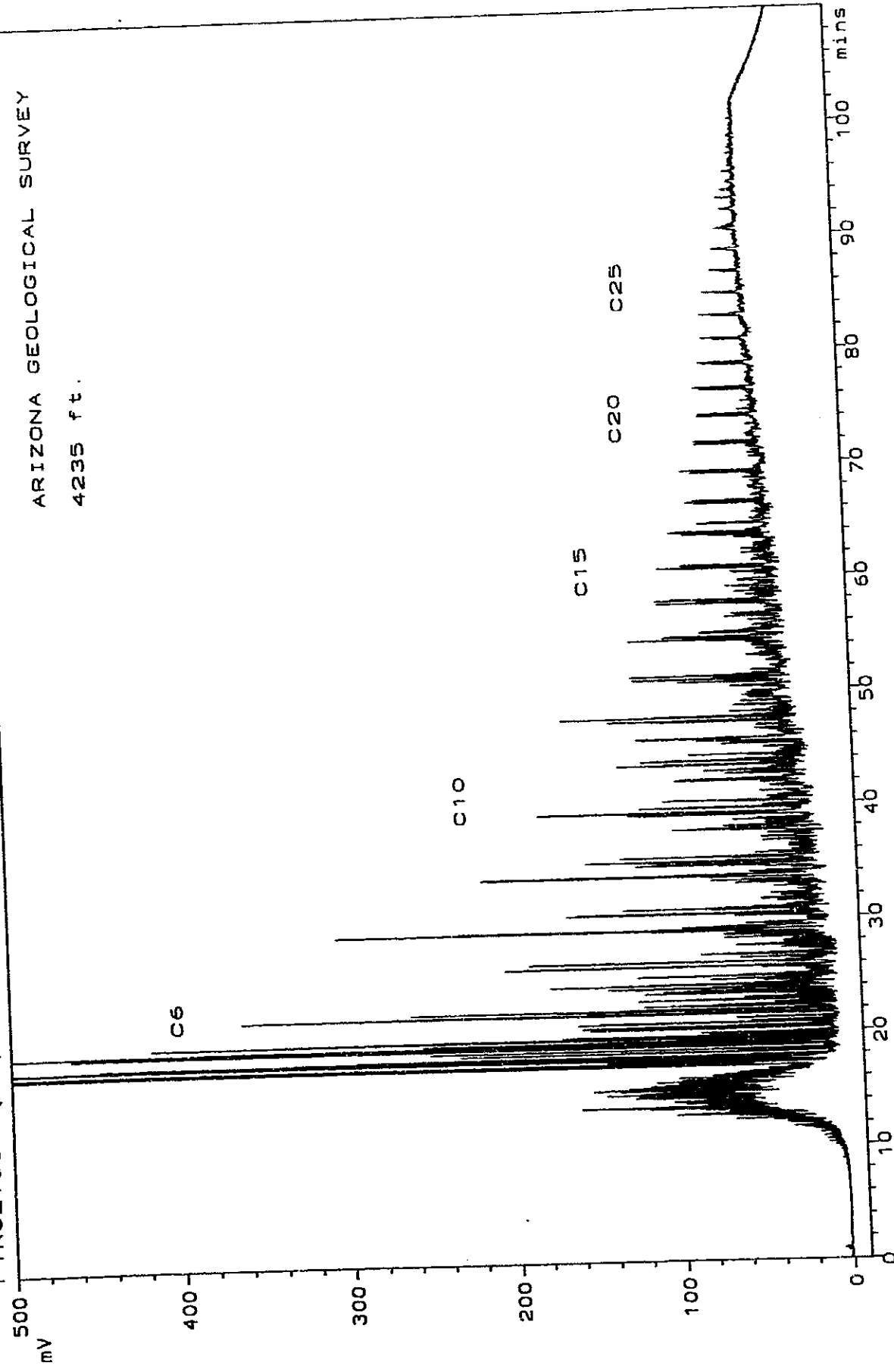
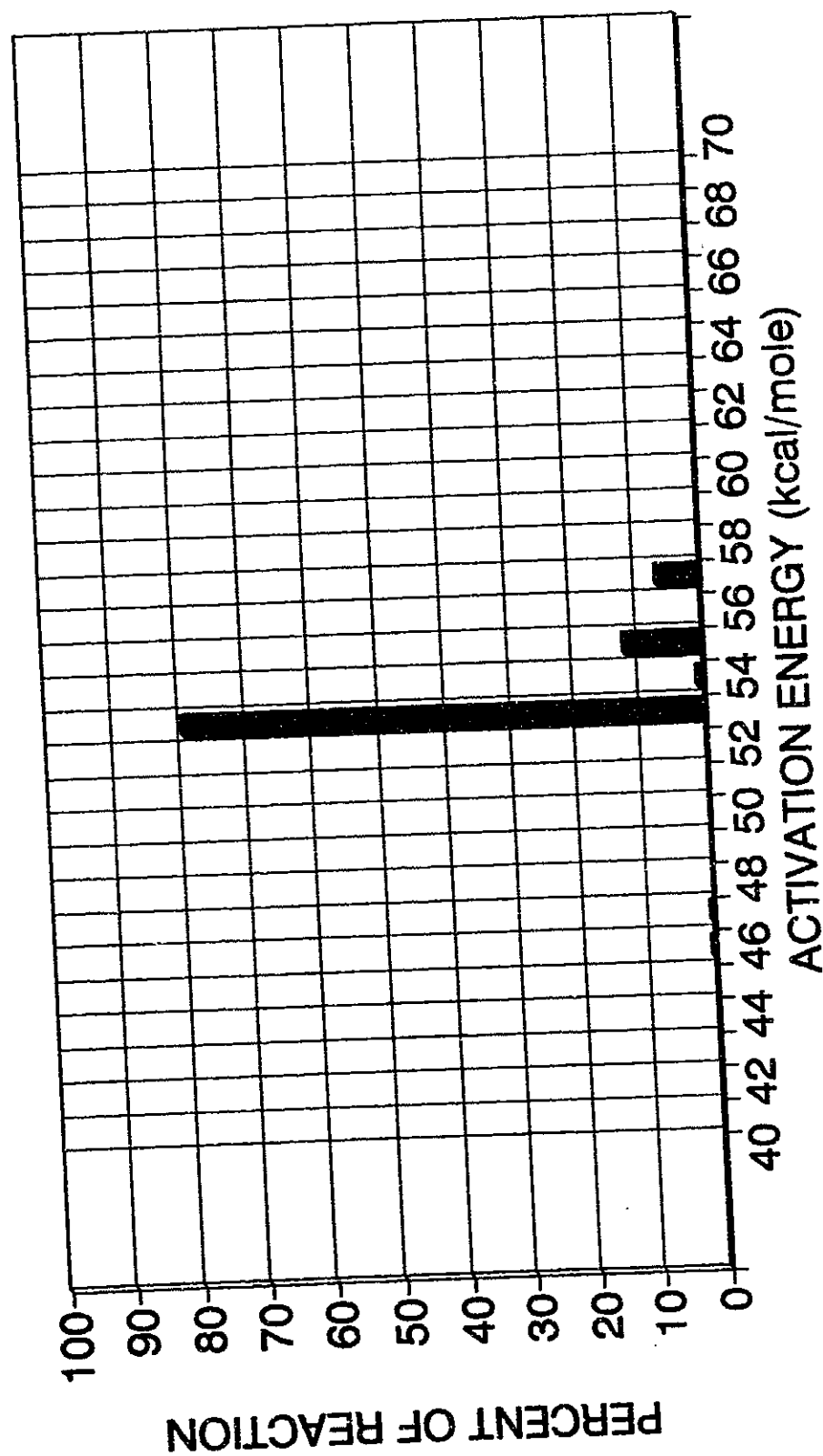


Figure 6.h
Humble Geochemical Services P.O. Box 789 Humble, Tx 77347

KINETIC ANALYSIS

1 ALPINE-FEDERAL: CORDUROY FM. 3975 ft.



$A = 4.0475E+13/\text{sec}$

Figure 7
Humble Geochemical Services PO Box 789 Humble TX 77347

GEOLOGICAL MODEL OF KINETIC DATA TEMPERATURE AND RATE OF OIL GENERATION

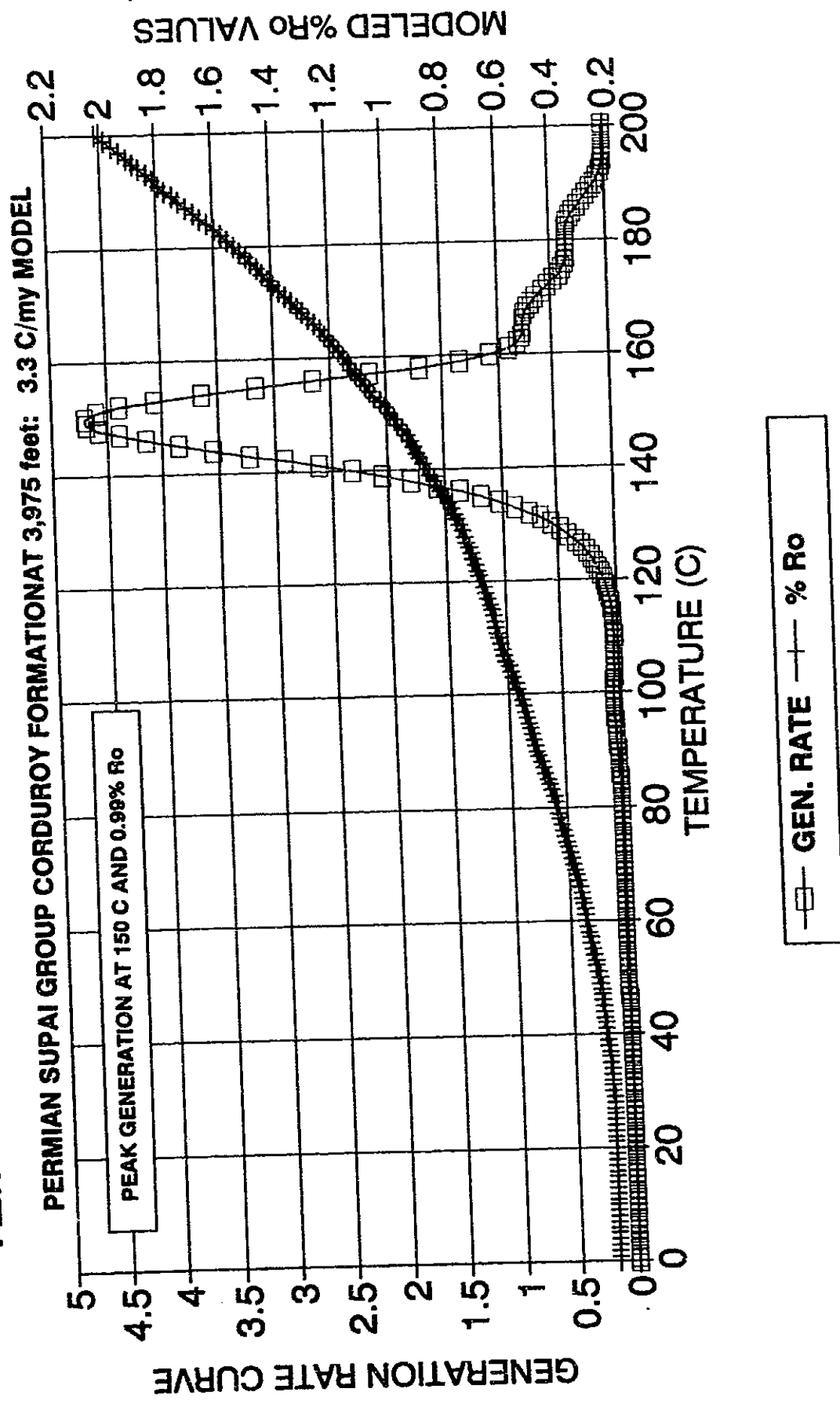


Figure 8
Humble Geological Services PC Box 780 Humble TX 77117

GEOLOGICAL MODEL OF KINETIC DATA TEMPERATURE AND RATE OF OIL GENERATION

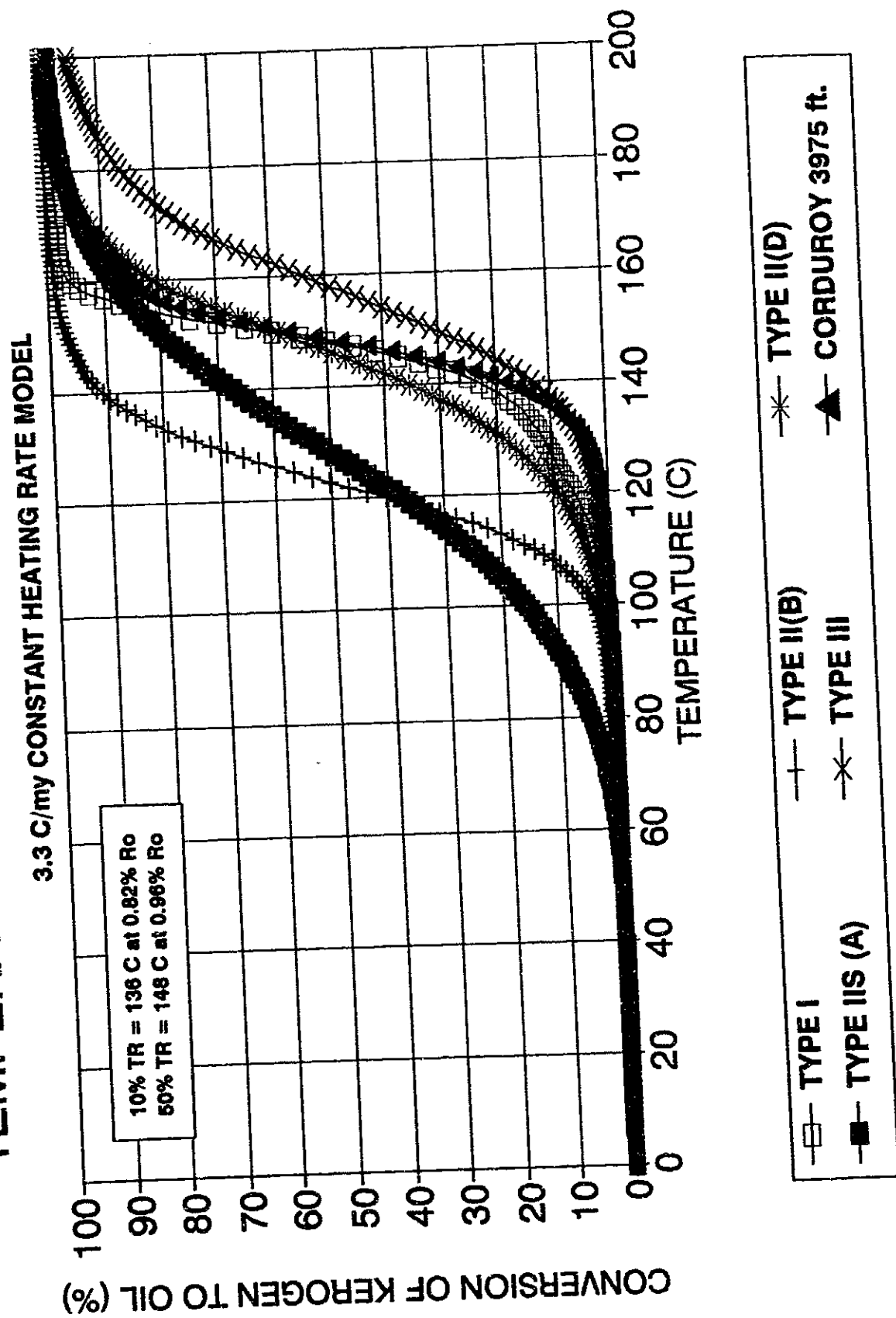


Figure 9
Kinetic Geochemical Correlation for Day 700 - Sample T-7717

Appendix I.1

VITRINITE REFLECTANCE AND VISUAL KEROGEN REPORT

Company: Arizona Geological Survey
Tucson, AZ
Attn: Steven L. Rauzi

Well Name: #1 Alpine Federal test
Apache County, Arizona

Sample Type: Core

The following pages are results of kerogen, thermal alteration index (TAI), vitrinite reflectance histograms, and a comparison of source rock quality based on pyrolysis and microscopy. Three samples 3305-4235 ft. (Appendix I.2) were studied in transmitted light and four samples were examined in reflected light (Table II) where they are compared with pyrolysis derived source parameters.

Conclusions

1. Kerogen in the 3305 and 3340 ft. Dakota samples is coaly, and would be a probable gas source at higher maturity level ($> 0.70\% R_o$).
2. Kerogen in the 3878 and 4235 ft. Supai Group samples is dominantly the algal-amorphous type and would be an excellent liquid hydrocarbon source at higher level of maturity ($> .55\% R_o$).
3. Normally vitrinite reflectance increases with increasing depth of burial, yet the samples below 3340 feet, have lower vitrinite reflectance. However, the coaly partings and particles are probably not autochthonous but were formed elsewhere and subsequently deposited in the Dakota sandstone. Fracturing of the coaly bands with subsequent carbonate infilling also suggests sediment transport.
4. Palynofacies indicate the Dakota samples were probably deposited in a near shore beach environment while the algal-amorphous environment was normal anoxic marine.
5. The high hydrogen indexes of 381-392 in the Supai Group cores are confirmed by the bright yellow-orange fluorescence of the algal amorphous kerogen. The fluorescence is not from oil staining as shown on the log, and in high S1 values of 0.96 and 4.25 mg's/gm as the kerogen has been demineralized through HF and HCL acidization.
6. Immaturity of intervals 3878 and 4235 ft. is in agreement with the very high S2 values of 12.29 and 16.66 mg's hydrocarbons/gm rock, respectively, indicative of only minor conversion of kerogen to petroleum.

THERMAL ALTERATION, KERGEN TYPE, AND PALYNOFACIES DATA

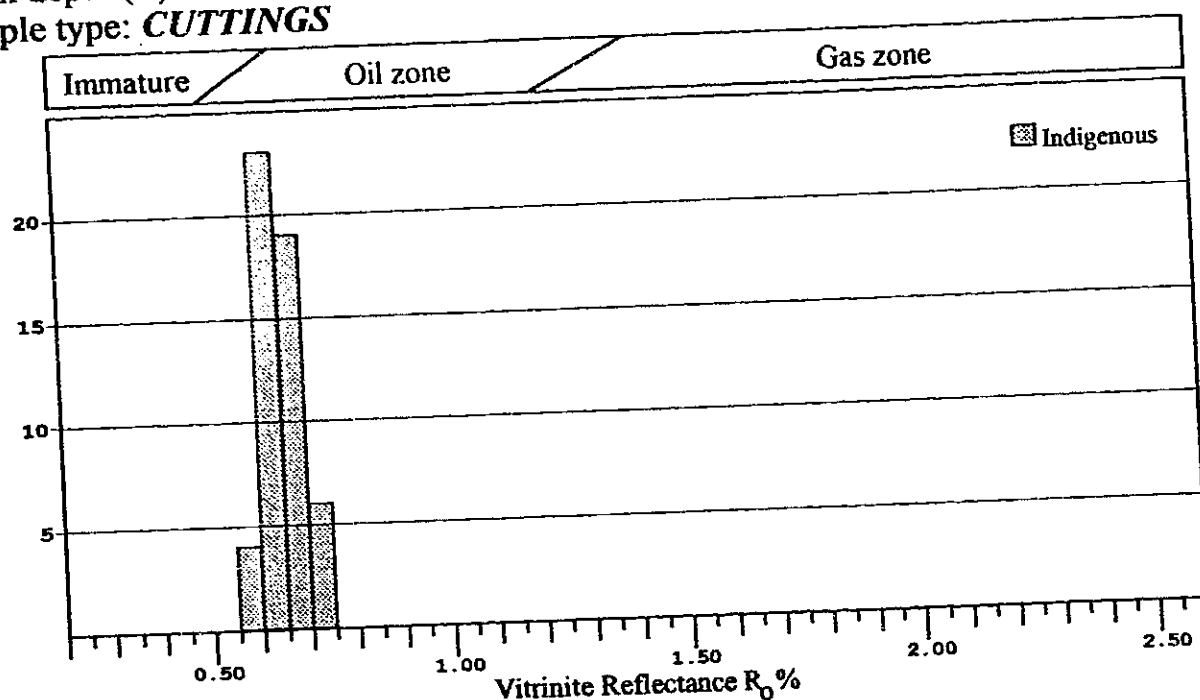
DATE 5-26-94		WELL: Alpine Fed		LOCATION: ARIZ.		DEPTH FT	M	THERMAL ALTERATION INDEX (TAI)	% SOURCE MATERIAL	PRESERVATION	RECOVERY	PALYNOFACIES	FLUORESCENCE	Palyomorph Key A = Abundant C = Common V = Present R = Rare N = None Seen	REMARKS
COLOR		THERMAL ALTERATION INDEX (TAI)		% SOURCE MATERIAL											
GREENISH LIGHT YELLOW	YELLOW	YELLOW - ORANGE	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	1 UNALTERED	1	1	1	1	1	1	1	1	1
YELLOW - ORANGE	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	2 SLIGHT ALTERATION	2	2	2	2	2	2	2	2	2
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	3 MODERATE ALTERATION	3	3	3	3	3	3	3	3	3
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	4 STRONG ALTERATION	4	4	4	4	4	4	4	4	4
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	5 SEVERE ALTERATION	5	5	5	5	5	5	5	5	5
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	6 AMORPHOUS DEBRIS	6	6	6	6	6	6	6	6	6
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	7 FINELY DISSEMINATED	7	7	7	7	7	7	7	7	7
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	8 WOODY PLANT DEBRIS	8	8	8	8	8	8	8	8	8
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	9 COALY FRAGMENTS	9	9	9	9	9	9	9	9	9
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	10 ALGAL DEBRIS	10	10	10	10	10	10	10	10	10
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	11 PALYNOFACIES	11	11	11	11	11	11	11	11	11
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	12 GOOD	12	12	12	12	12	12	12	12	12
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	13 FAIR	13	13	13	13	13	13	13	13	13
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	14 POOR	14	14	14	14	14	14	14	14	14
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	15 VERY POOR RECOVERY	15	15	15	15	15	15	15	15	15
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	16 BARELY OF O.M.	16	16	16	16	16	16	16	16	16
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	17 NEARLY NONE	17	17	17	17	17	17	17	17	17
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	18 CONTINENTAL	18	18	18	18	18	18	18	18	18
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	19 LACUSTRINE	19	19	19	19	19	19	19	19	19
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	20 UNKNOWN	20	20	20	20	20	20	20	20	20
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	21 YELLOW - ORANGE	21	21	21	21	21	21	21	21	21
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	22 ORANGE	22	22	22	22	22	22	22	22	22
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	23 RED - ORANGE	23	23	23	23	23	23	23	23	23
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	24 REFLECTANCE	24	24	24	24	24	24	24	24	24
YELLOW	ORANGE - BROWN	ORANGE - BROWN	BROWN	DARK BROWN - BLACK	DARK BROWN - BLACK	25 MEAN R ₀ %	25	25	25	25	25	25	25	25	25

12-8-93

HUMBLE GEOCHEMICAL SERVICES

Appendix I.3

Customer: **ARIZONA GEOL. SURVEY**
 Well name: **#1 ALPINE FEDERAL**
 Sample ID: **PKD. COAL**
 Mean depth (ft): **3305**
 Sample type: **CUTTINGS**



Indigenous population statistics

Mean: **0.65** Min: 0.55 Max: 0.75 Std. Dev.: 0.03 Count: 52

Total population statistics

Mean: 0.65 Min: 0.58 Max: 0.71 Std. Dev.: 0.03 Count: 52

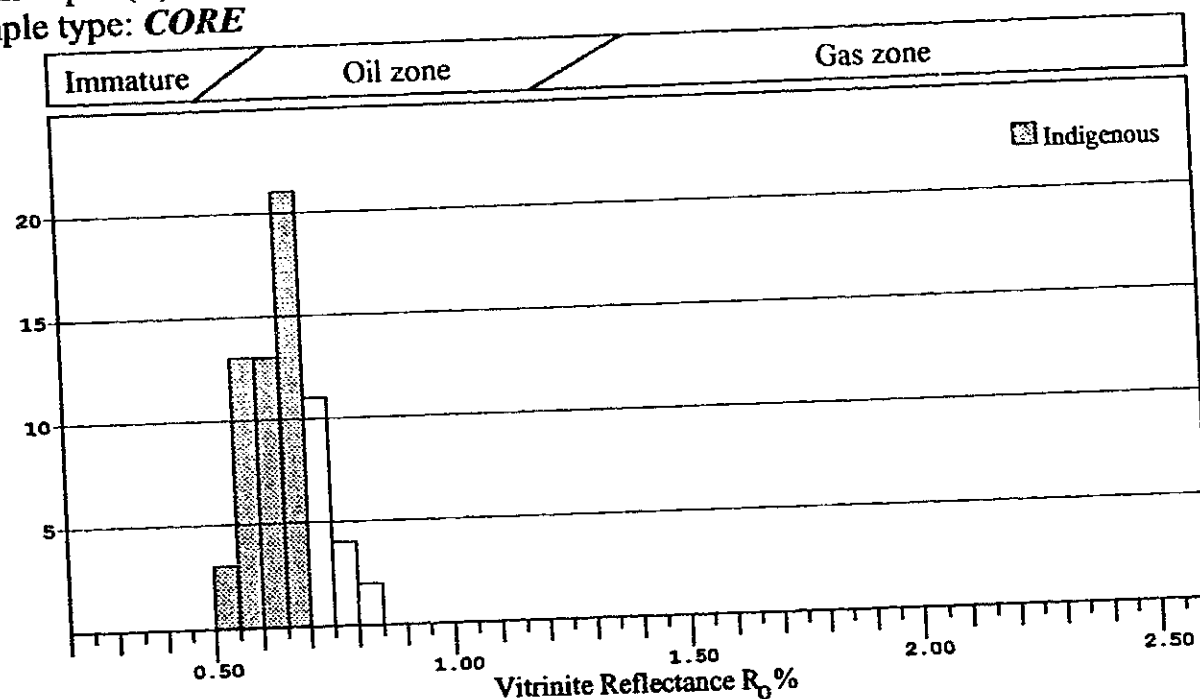
01 - 0.58 <	21 - 0.63 <	41 - 0.68 <
02 - 0.59 <	22 - 0.63 <	42 - 0.68 <
03 - 0.59 <	23 - 0.63 <	43 - 0.68 <
04 - 0.59 <	24 - 0.64 <	44 - 0.69 <
05 - 0.60 <	25 - 0.64 <	45 - 0.69 <
06 - 0.61 <	26 - 0.64 <	46 - 0.69 <
07 - 0.61 <	27 - 0.64 <	47 - 0.70 <
08 - 0.61 <	28 - 0.65 <	48 - 0.70 <
09 - 0.62 <	29 - 0.65 <	49 - 0.70 <
10 - 0.62 <	30 - 0.65 <	50 - 0.70 <
11 - 0.62 <	31 - 0.65 <	51 - 0.70 <
12 - 0.62 <	32 - 0.66 <	52 - 0.71 <
13 - 0.62 <	33 - 0.66 <	
14 - 0.62 <	34 - 0.66 <	
15 - 0.62 <	35 - 0.67 <	
16 - 0.62 <	36 - 0.67 <	
17 - 0.63 <	37 - 0.68 <	
18 - 0.63 <	38 - 0.68 <	
19 - 0.63 <	39 - 0.68 <	
20 - 0.63 <	40 - 0.68 <	

Note: Reflectance values rounded to nearest hundredth. [<] indicates indigenous reflectance value

Humble Geochemical Services

Appendix I.4

Customer: **ARIZONA GEOL. SURVEY**
 Well name: **#1 ALPINE FEDERAL**
 Sample ID: **PKD. COAL**
 Mean depth (ft): **3340**
 Sample type: **CORE**



Indigenous population statistics

Mean: 0.62 Min: 0.53 Max: 0.69 Std. Dev.: 0.04 Count: 50

Total population statistics

Mean: 0.65 Min: 0.53 Max: 0.80 Std. Dev.: 0.06 Count: 67

01 - 0.53 <	21 - 0.62 <	41 - 0.67 <	61 - 0.74
02 - 0.54 <	22 - 0.62 <	42 - 0.67 <	62 - 0.75
03 - 0.54 <	23 - 0.62 <	43 - 0.67 <	63 - 0.75
04 - 0.56 <	24 - 0.63 <	44 - 0.67 <	64 - 0.76
05 - 0.56 <	25 - 0.63 <	45 - 0.67 <	65 - 0.77
06 - 0.57 <	26 - 0.63 <	46 - 0.67 <	66 - 0.80
07 - 0.57 <	27 - 0.64 <	47 - 0.68 <	67 - 0.80
08 - 0.57 <	28 - 0.64 <	48 - 0.68 <	
09 - 0.57 <	29 - 0.64 <	49 - 0.68 <	
10 - 0.57 <	30 - 0.65 <	50 - 0.69 <	
11 - 0.58 <	31 - 0.65 <	51 - 0.70	
12 - 0.58 <	32 - 0.65 <	52 - 0.70	
13 - 0.58 <	33 - 0.65 <	53 - 0.71	
14 - 0.58 <	34 - 0.66 <	54 - 0.72	
15 - 0.59 <	35 - 0.66 <	55 - 0.72	
16 - 0.59 <	36 - 0.66 <	56 - 0.72	
17 - 0.60 <	37 - 0.66 <	57 - 0.72	
18 - 0.61 <	38 - 0.66 <	58 - 0.73	
19 - 0.62 <	39 - 0.66 <	59 - 0.73	
20 - 0.62 <	40 - 0.66 <	60 - 0.73	

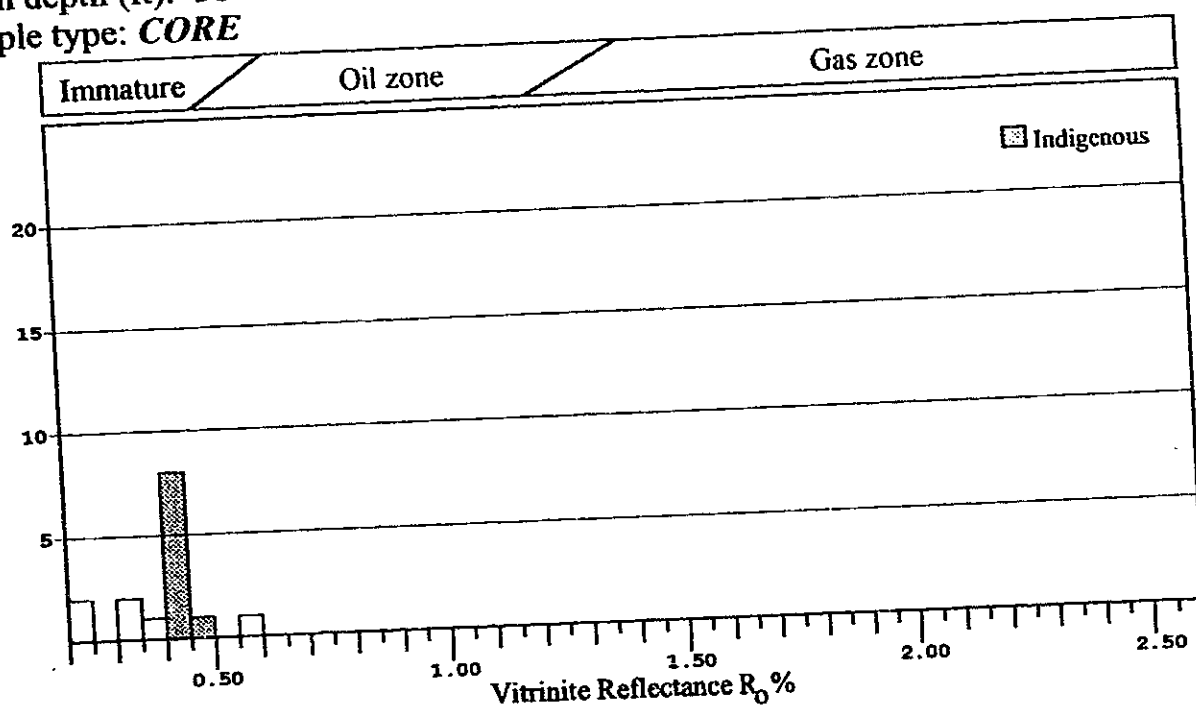
Note: Reflectance values rounded to nearest hundredth, [<] indicates indigenous reflectance value

Humble Geochemical Services

Fri Jun 17 1994/2.0

Appendix I.5

Customer: ARIZON GEOL. SURVEY
Well name: #1 ALPINE FEDERAL
Sample ID: SUPAI GRP.
Mean depth (ft): 3878
Sample type: CORE



Indigenous population statistics

Mean: 0.42 Min: 0.40 Max: 0.54 Std. Dev.: 0.02 Count: 09

Total population statistics

Mean: 0.39 Min: 0.23 Max: 0.55 Std. Dev.: 0.08 Count: 15

- 01 - 0.23
- 02 - 0.24
- 03 - 0.31
- 04 - 0.32
- 05 - 0.37
- 06 - 0.40 <
- 07 - 0.40 <
- 08 - 0.40 <
- 09 - 0.41 <
- 10 - 0.43 <
- 11 - 0.43 <
- 12 - 0.43 <
- 13 - 0.44 <
- 14 - 0.45 <
- 15 - 0.55

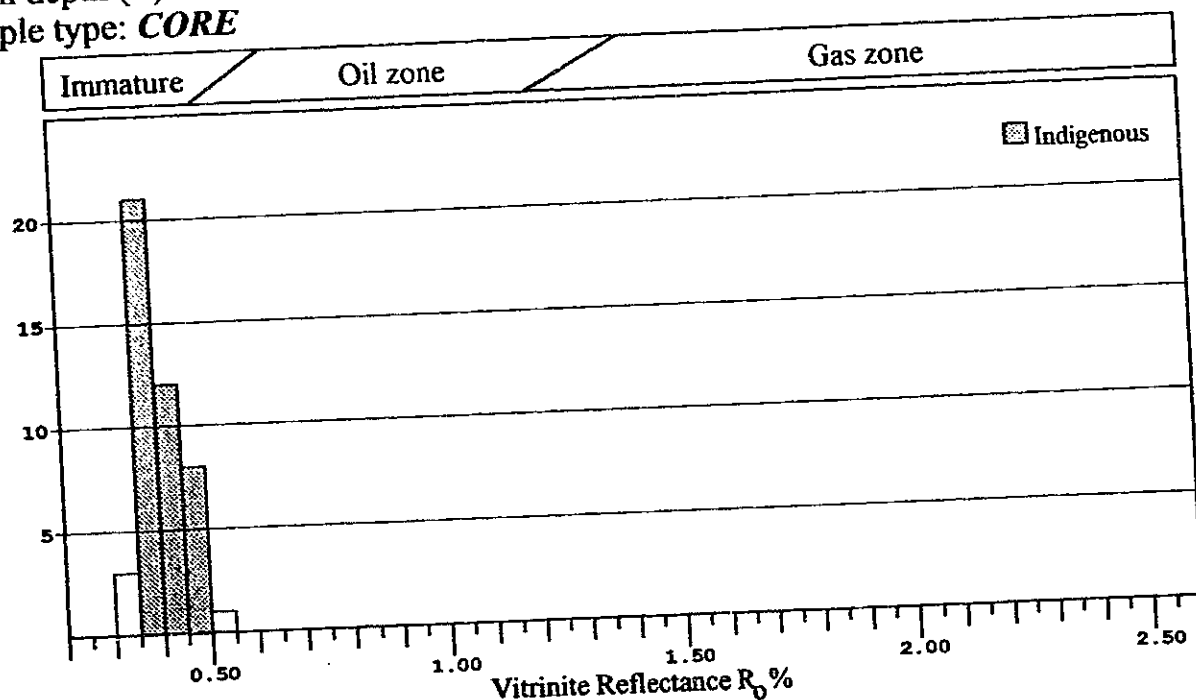
Note: Reflectance values rounded to nearest hundredth, [<] indicates indigenous reflectance value

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Mon Jun 20 1994/2.0

Appendix I.6

Customer: **ARIZONA GEOL. SURVEY**
 Well name: **#1 ALPINE FEDERAL**
 Sample ID: **FT. APACHE**
 Mean depth (ft): **4235**
 Sample type: **CORE**



Indigenous population statistics

Mean: 0.40 Min: 0.35 Max: 0.49 Std. Dev.: 0.04 Count: 41

Total population statistics

Mean: 0.40 Min: 0.32 Max: 0.50 Std. Dev.: 0.05 Count: 45

01 - 0.32	21 - 0.38 <	41 - 0.48 <
02 - 0.33	22 - 0.38 <	42 - 0.48 <
03 - 0.34	23 - 0.38 <	43 - 0.48 <
04 - 0.35 <	24 - 0.39 <	44 - 0.49 <
05 - 0.35 <	25 - 0.40 <	45 - 0.50
06 - 0.35 <	26 - 0.40 <	
07 - 0.35 <	27 - 0.41 <	
08 - 0.35 <	28 - 0.41 <	
09 - 0.36 <	29 - 0.41 <	
10 - 0.36 <	30 - 0.41 <	
11 - 0.36 <	31 - 0.42 <	
12 - 0.36 <	32 - 0.42 <	
13 - 0.36 <	33 - 0.42 <	
14 - 0.36 <	34 - 0.42 <	
15 - 0.37 <	35 - 0.44 <	
16 - 0.37 <	36 - 0.44 <	
17 - 0.37 <	37 - 0.45 <	
18 - 0.37 <	38 - 0.45 <	
19 - 0.38 <	39 - 0.45 <	
20 - 0.38 <	40 - 0.47 <	

Note: Reflectance values rounded to nearest hundredth, [<] indicates indigenous reflectance value

Humble Geochemical Services

Fri Jun 17 1994/2.0

Humble Geochemical Services
Division of Humble Instruments & Services, Inc.

P.O. Box 789
Humble, Texas 77347

Telephone: (713) 540-6050 Fax: (713) 540-2864

Generalized Chemical and Physical Characteristics of Kerogen (when immature)						
KEROGEN TYPE	HYDROGEN INDEX	OXYGEN INDEX	ELEMENTAL H/C	ORGANIC MATTER	DEPOSITIONAL ENVIRONMENT	INTERNAL STRUCTURES
I	700 - 1000+	10 - 40	> 1.4	ALGAL; AMORPHOUS; RARE TERRESTRIAL	ANOXIC (SALINE); LACUSTRINE; RARE MARINE	FINELY LAMINATED
II	350 - 700	20 - 60	1.2 - 1.4	ALGAL; AMORPHOUS; COMMON TERRESTRIAL	ANOXIC; MARINE	LAMINATED, WELL BEDDED
II / III	200 - 350	40 - 80	1 - 1.2	MIXED MARINE, TERRESTRIAL	VARIABLE; DELTAIC	POORLY BEDDED
III	50 - 200	50 - 150	0.7 - 1.0	TERRESTRIAL, MOSTLY "VITRINITES"; DEGRADED ALGAL	MILDLY OXIC; SHELF/SLOPE; COALS	POORLY BEDDED; BIOTURBATED
IV	< 50	20 - 200	0.4 - 0.7	HIGHLY OXIDIZED; REWORKED	HIGHLY OXIC; ANYWHERE	MASSIVE; BIOTURBATED
						DRY GAS

Modified from Jones, R. W., 1984, Comparison of Carbonate and Shale Source Rocks, pp. 163-180, In Petroleum Geochemistry and Source Rock Potential of Carbonate Rocks, AAPG Studies in Geology 18, J. Palacas, ed.

Preliminary Report on Geochemical Analysis

Client: Arizona Geological Survey
Operator: New Mexico State University **Driller:** Tonto Drilling Services
Well Name: 1 Alpine-Federal **Location:** 23-6N-30E
County: Apache **State:** Arizona
Ground elevation: 8,556 feet **Depth Interval:** 504 - 4505 (TD) feet
Sample type: Core

Sample Preparation: Samples were washed and ground to pass through a 60 mesh (250 micron) sieve.

Sample Analysis: Samples were analyzed to evaluate their organic richness, petroleum content, petroleum potential, kerogen type, and thermal maturity by total organic carbon (TOC) and Rock-Eval analyses. Random and selected samples were checked to confirm results. Accuracy and reproducibility were checked by analysis of a standard every ten samples.

TOC and Rock-Eval Results Discussion:

The TOC and Rock-Eval data are shown in Table 1. This table shows the depth and age/formation with the analytical results and calculation of various interpretive ratios. A summary of interpretive guidelines for these data is included as Appendix I. Also, shown on these data tables are samples on which analytical results were checked and confirmed as well as the condition of the pyrogram. The pyrogram is a graphic representation of the Rock-Eval S2 peak. If the S2 value is low (< 0.50 mg hydrocarbons/g rock) and the S2 pyrogram is flat, the Rock-Eval Tmax value is not usually accurate due to the difficulty of finding a maximum on a flat peak. A sample having a low S2 value but a distinct S2 peak on the pyrogram has a Tmax value reported. Two samples had low temperature S2 peaks (4325 and 4435 feet). This is probably extractable organic matter (EOM) which is cracked in the S2 peak. If this is correct, the S2 value would be reduced and the S1 value increased. Normal pyrograms have distinct and smooth S2 peaks and always have a Tmax value reported.

The geochemical analysis of core samples from the 1 Alpine-Federal geothermal well in Apache county, Arizona revealed a number of organic rich intervals. A plot of remaining generation potential (Rock-Eval S2) versus TOC (Figure 1) shows numerous intervals with greater than 1.00% TOC. The values plotted as an "x" are samples having less than 1.00% TOC whereas the "o" values have TOC contents greater than 1.00%. The "x" values are insignificant due to their low organic carbon contents and should not be considered indicative of significant petroleum generation potential.

Intervals at 3294, 3305 and 3340 feet in the Cretaceous have TOC values of 3.11%, 6.59% and 8.58%, respectively. Likewise, the Permian San Andres limestone reaches 12.77% TOC at 3397 feet and 3.70% at 3410 feet. In the Corduroy formation of the Supai group of Permian age numerous intervals exceed 1.00% TOC including 3878 feet (3.22%), 3975 feet shale and carbonate samples (7.21% and 1.55%, respectively), 4028 feet (3.40%), 4065 feet (1.40%), and from 4125 to 4145 feet (1.86%, 1.65%, and 2.26%). Finally, the Fort Apache member of the Supai group of Permian age reaches 4.25% TOC. This plot is also indicative of the potential of these samples for oil and gas. The Cretaceous intervals are largely gas prone organic matter whereas the Permian aged samples are more oil prone or have mixed oil/gas potential. This is also illustrated by a classical modified van Krevelen plot of hydrogen index ($S2 \times 100/TOC$) versus oxygen index ($S3 \times 100/TOC$) (Figure 2).

A plot of hydrogen index versus Rock-Eval Tmax illustrates the petroleum potential with regard to thermal maturity (Figure 3). The majority of the samples are in the early to mid oil window. Two of the Cretaceous samples analyzed have fairly high Tmax values which would normally be indicative of considerable conversion of organic matter to petroleum products, i.e., peak oil generation. However, the Cretaceous Tmax values appear to be anomalous. This is illustrated in Figure 4 where a depth versus Tmax plot shows their advanced maturity when compared to the Permian rocks at 4000 feet and deeper. The high Tmax values are not supported by the free petroleum content of these samples where the production index (free oil (S1) divided by the sum of the free oil and remaining potential (S2)) are less than 0.05. This is indicative of less than 5% conversion of kerogen to petroleum which is very low for this presumed level of thermal maturity. Tmax is, in fact, a kinetic parameter and is dependent on organic matter composition (kerogen type). However, it is unusual to have such a large offset from the overall trend in the well. These maturity differences need to be examined by utilizing vitrinite reflectance and thermal alteration index analyses. The organic matter type will also be assessed by visual kerogen assessment of the maceral percentages.

In summary, the Cretaceous rocks are organic rich but have hydrogen contents which are indicative of gas generating source rocks. The Rock-Eval Tmax values do not appear to be accurately reflecting advanced maturity based on the low level of conversion of organic matter in these samples. This will be further assessed by completing visual maturity analysis.

The Permian aged rocks are oil prone or have mixed oil and gas potential. Their maturity is early to mid oil window. Their remaining potential to generate liquid petroleum products is high. In areas where they may be more mature they have the capability to generate from 128 to 617 barrels of petroleum per acre-foot based on the potential yields calculated from their present day potential, i.e., Rock-Eval S2 values. Their potential as petroleum source rocks is largely dependent on volumetric considerations and thermal maturity.

Both dead oil and oil shows were reported at the contact of the Tertiary and the Cretaceous, below the San Andres limestone, and 196 feet above the top of the Fort Apache unit in the Corduroy formation (4028 feet). These intervals are being analyzed by thermal extraction/gas chromatography to obtain a fingerprint of the free oil in these rocks. In addition pyrolysis/gas chromatography is also being performed on the organic matter to assess kerogen type.

ARIZONA GEOLOGICAL SURVEY

WELL NAME: #1 Alpine-Federal
ATTN: Steven Rauzi

SAMPLE NO.	DEPTH (ft)	AGE/FORMATION	TOC AND ROCK-EVAL DATA				INTERPRETIVE RATIOS					NOTES		
			TOC	S1	S2	S3	TMAX	HI	OI	S2/S3	PI	SI/TOC	Check	Pyrogram
1	504	Tertiary:	0.05	0.04	0.01	0.16	---	20	320	0.06	0.80	80		f
2	553	Datil fm	0.04	0.01	0.00	0.15	---	0	375	0.00	1.00	25		f
3	604		0.03	0.07	0.00	0.13	---	0	433	0.00	1.00	233		f
4	652		0.04	0.02	0.00	0.09	---	0	225	0.00	1.00	50	c	f
5	714		0.02	0.02	0.00	0.12	---	0	600	0.00	1.00	100		f
6	754		0.07	0.03	0.00	0.18	---	0	257	0.00	1.00	43		f
7	804		0.02	0.01	0.00	0.10	---	0	500	0.00	1.00	50		f
8	854		0.04	0.01	0.02	0.11	---	50	275	0.18	0.33	25		f
9	904		0.05	0.01	0.00	0.11	---	0	220	0.00	1.00	20		f
10	954		0.04	0.01	0.01	0.15	---	25	375	0.07	0.50	25		f
11	1002		0.04	0.00	0.00	0.11	---	0	275	0.00	---	0		f
12	1064		0.04	0.01	0.00	0.10	---	0	250	0.00	1.00	25	c	f
13	1114	Tertiary:	0.04	0.01	0.00	0.16	---	0	400	0.00	1.00	25		f
14	1164	Baca fm.	0.06	0.01	0.00	0.19	---	0	317	0.00	1.00	17		f
15	1214		0.05	0.02	0.01	0.21	---	20	420	0.05	0.67	40		f
16	1274		0.04	0.01	0.00	0.15	---	0	375	0.00	1.00	25		f
17	1314		0.03	0.01	0.00	0.13	---	0	433	0.00	1.00	33		f
18	1384		0.05	0.00	0.00	0.11	---	0	220	0.00	---	0		f
19	1434		0.04	0.01	0.00	0.17	---	0	425	0.00	---	25	c	f
20	1481		0.05	0.00	0.00	0.21	---	0	420	0.00	---	0		f
21	1534		0.03	0.00	0.00	0.16	---	0	533	0.00	---	0		f
22	1584		0.07	0.01	0.01	0.13	---	14	186	0.08	0.50	14		f
23	1634		0.06	0.00	0.00	0.20	---	0	333	0.00	---	0		f
24	1694		0.06	0.01	0.00	0.11	---	0	183	0.00	1.00	17		f
25	1750		0.09	0.03	0.02	0.13	---	22	144	0.15	0.60	33	c	f

PAGE 1

ARIZONA GEOLOGICAL SURVEY

WELL NAME: #1 Alpine-Federal
ATTN: Steven Rauzi

SAMPLE NO.	DEPTH (ft)	TOC AND ROCK-EVAL DATA					INTERPRETIVE RATIOS					NOTES	
		TOC	S1	S2	S3	TMAX	HI	OI	S2/S3	PI	SI/TOC	Check	Pyrogram
26	1800	0.05	0.00	0.00	0.12	---	0	240	0.00	---	0		f
27	1848	0.06	0.01	0.01	0.13	---	17	217	0.08	0.50	17	c	f
28	1902	0.04	0.00	0.00	0.09	---	0	225	0.00	---	0		f
29	1953	0.03	0.00	0.00	0.14	---	0	467	0.00	---	0		f
30	2002	0.04	0.01	0.03	0.20	---	75	500	0.15	0.25	25		f
31	2052	0.04	0.01	0.00	0.16	---	0	400	0.00	1.00	25		f
32	2104	0.03	0.01	0.01	0.26	---	33	867	0.04	0.50	33		f
33	2164	0.04	0.00	0.01	0.12	---	25	300	0.08	0.00	0		f
34	2204	0.04	0.01	0.00	0.15	---	0	375	0.00	1.00	25	c	f
35	2254	0.03	0.01	0.00	0.17	---	0	567	0.00	1.00	33		f
36	2304	0.06	0.01	0.00	0.16	---	0	267	0.00	1.00	17		f
37	2364	0.07	0.01	0.00	0.15	---	0	214	0.00	1.00	14		f
38	2404	0.05	0.00	0.00	0.07	---	0	140	0.00	---	0	c	f
39	2464	0.03	0.00	0.00	0.16	---	0	533	0.00	---	0		f
40	2504	0.13	0.01	0.02	0.13	---	15	100	0.15	0.33	8		f
41	2560	0.06	0.01	0.01	0.06	---	17	100	0.17	0.50	17	c	f
42	2604	0.08	0.02	0.02	0.16	---	25	200	0.13	0.50	25		f
43	2663	0.14	0.04	0.02	0.12	---	14	86	0.17	0.67	29		f
44	2704	0.06	0.01	0.05	0.09	---	83	150	0.56	0.17	17		f
45	2754	0.06	0.00	0.00	0.07	---	0	117	0.00	---	0	c	f
46	2802	0.07	0.00	0.03	0.10	---	43	143	0.30	0.00	0		f
47	2862	0.12	0.01	0.05	0.14	---	42	117	0.36	0.17	8	c	f
48	2902	0.03	0.02	0.02	0.08	---	67	267	0.25	0.50	67		f
49	2966	0.09	0.01	0.04	0.09	---	44	100	0.44	0.20	11		f
50	3106	0.12	0.02	0.02	0.12	---	17	100	0.17	0.50	17		f

PAGE 2

HGS 94-64

ARIZONA GEOLOGICAL SURVEY

WELL NAME: #1 Alpine-Federal
ATTN: Steven Rauzi

SAMPLE NO.	DEPTH (ft)	TOC AND ROCK-EVAL DATA				INTERPRETIVE RATIOS					NOTES		
		TOC	S1	S2	S3	TMAX	HI	OI	S2/S3	PI	SI/TOC	Check	Pyrogram
51	Tertiary: 3206 (red beds)	0.15	0.02	0.03	0.09	---	20	60	0.33	0.40	13		f
52		0.10	0.02	0.10	0.09	---	100	90	1.11	0.17	20		f
53		0.05	0.03	0.09	0.16	---	180	320	0.56	0.25	60		f
54	Cretaceous: 3275 Dakota SS	0.08	0.01	0.08	0.07	429	100	88	1.14	0.11	13		n
55		0.80	0.04	0.56	0.11	432	70	14	5.09	0.07	5		n
56	3285	0.26	0.03	0.14	0.09	429	54	35	1.56	0.18	12		n
57	3294	3.11	0.06	2.67	0.17	436	86	5	15.71	0.02	2	c	n
58	3305	6.59	0.14	3.59	0.36	449	54	5	9.97	0.04	2	c	n
59	3315	0.90	0.03	0.96	0.16	433	107	18	6.00	0.03	3		n
60	3330	0.54	0.02	0.44	0.09	432	81	17	4.89	0.04	4		n
61	3340	8.58	0.43	8.60	0.60	444	100	7	14.33	0.05	5	c	n
62	3350	0.84	0.01	0.32	0.14	439	38	17	2.29	0.03	1		n
63	3360	0.52	0.01	0.24	0.24	434	46	46	1.00	0.04	2		n
64	Permian: 3380 San Andres LS	0.15	0.03	0.04	0.25	---	27	167	0.16	0.43	20	c	f
65		0.26	0.03	0.45	0.34	427	173	131	1.32	0.06	12		n
66	3390	0.53	0.07	1.31	0.45	425	247	85	2.91	0.05	13		n
67	3397	12.77	1.04	27.95	0.69	420	219	5	40.51	0.04	8	c	n
68	3400	0.05	0.02	0.10	0.28	433	200	560	0.36	0.17	40		n
69	3410	3.70	0.55	15.38	0.70	420	416	19	21.97	0.03	15		n
70	3420	0.78	0.20	2.87	0.57	419	368	73	5.04	0.07	26		n
71	3430	0.20	0.03	0.33	0.42	431	165	210	0.79	0.08	15		n
72	3435	0.31	0.02	0.14	0.27	425	45	87	0.52	0.12	6		n
73	Permian: 3495 Glorieta SS	0.06	0.05	0.04	0.22	---	67	367	0.18	0.56	83		f
74		0.07	0.02	0.03	0.25	---	43	357	0.12	0.40	29	c	f
75		0.04	0.04	0.01	0.26	---	25	650	0.04	0.80	100	c	f

FIGS 94-94

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PAGE 3

HGS 04-64

ARIZONA GEOLOGICAL SURVEY

WELL NAME: #1 Alpine-Federal
ATTN: Steven Rauzi

ATTN: Steven Rauzi

SAMPLE NO.	DEPTH (ft)	TOC AND ROCK-EVAL DATA	TMAX	INTERPRETIVE RATIOS	Check	Pyrogram	NOTES					
		TOC	S1	S2	S3	HI	OI S2/S3	PI S1/TOC				
76	3555	0.04	0.07	0.01	0.25	---	25	625	0.04	0.88	175	f
77	3585	0.07	0.08	0.02	0.24	---	29	343	0.08	0.80	114	f
78	3615	0.12	0.04	0.04	0.28	---	33	233	0.14	0.50	33	f
79	3645	0.16	0.01	0.02	0.42	---	13	263	0.05	0.33	6	f
80	3690	0.14	0.00	0.00	0.33	---	0	236	0.00	---	0	f
Permian:												
Supai Group												
Corduroy fm												
81	3755	0.08	0.05	0.04	0.30	---	50	375	0.13	0.56	63	f
82	3785	0.06	0.01	0.01	0.20	---	17	333	0.05	0.50	17	f
83	3795	0.07	0.01	0.01	0.17	---	14	243	0.06	0.50	14	f
84	3805	0.03	0.01	0.02	0.14	---	67	467	0.14	0.33	33	f
85	3815	0.05	0.02	0.02	0.21	---	40	420	0.10	0.50	40	f
86	3825	0.02	0.02	0.00	0.18	---	0	900	0.00	1.00	100	f
87	3835	0.02	0.00	0.06	0.00	---	300	0	---	0.00	0	f
88	3845	0.16	0.00	0.03	0.11	---	19	69	0.27	0.00	0	f
89	3865	0.03	0.01	0.01	0.05	---	33	167	0.20	0.50	33	f
90	3878	3.22	0.96	12.29	0.63	436	382	20	19.51	0.07	30	c
91	3885	0.15	0.01	0.06	0.13	435	40	87	0.46	0.14	7	n
92	3905	0.15	0.04	0.02	0.23	---	13	153	0.09	0.67	27	f
93	3915	1.03	0.45	3.69	0.27	431	358	26	13.67	0.11	44	n
94	3925	0.19	0.03	0.09	0.19	431	47	100	0.47	0.25	16	n
95	3945	0.02	0.03	0.01	0.15	---	50	750	0.07	0.75	150	f
96	3965	0.09	0.07	0.22	0.11	438	244	122	2.00	0.24	78	n
97	3975	7.21	2.68	25.50	0.66	436	354	9	38.64	0.10	37	c
98	3975	1.55	0.56	5.81	0.64	434	375	41	9.08	0.09	36	n
99	3985	0.01	0.01	0.02	0.33	---	200	3300	0.06	0.33	100	f
100	4005	0.02	0.01	0.01	0.21	---	50	1050	0.05	0.50	50	c

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HGS 94-64

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Humble Geochemical Services

218 Higgins Street

Humble, Texas 77338

Phone 713 540-6050

ARIZONA GEOLOGICAL SURVEY

WELL NAME: #1 Alpine-Federal
ATTN: Steven Rauzi

SAMPLE NO.	DEPTH (ft.)	TOC AND ROCK-EVAL DATA					INTERPRETIVE RATIOS					NOTES	
		TOC	SI	S2	S3	TMAX	HI	OI	S2/S3	PI	SI/TOC	Check	Pyrogram
101	4015	0.20	0.02	0.01	0.14	---	5	70	0.07	0.67	10		f
102	4025	0.14	0.12	0.55	0.12	435	393	86	4.58	0.18	86		n
103	4028	3.54	2.43	18.30	0.50	435	517	14	36.60	0.12	69	c	n
104	4045	0.10	0.02	0.02	0.20	---	20	200	0.10	0.50	20		f
105	4060	0.18	0.11	0.59	0.20	434	328	111	2.95	0.16	61		n
106	4065	1.40	0.66	4.49	0.45	437	321	32	9.98	0.13	47		n
107	4085	0.02	0.03	0.02	0.19	---	100	950	0.11	0.60	150	c	f
108	4089	0.15	0.02	0.12	0.19	439	80	127	0.63	0.14	13		n
109	4105	0.02	0.01	0.01	0.20	---	50	1000	0.05	0.50	50		f
110	4115	0.04	0.01	0.01	0.08	---	25	200	0.13	0.50	25		f
111	4125	1.86	0.31	5.70	0.30	431	306	16	19.00	0.05	17	c	n
112	4130	1.65	0.23	4.48	0.34	433	272	21	13.18	0.05	14		n
113	4145	2.26	0.28	6.02	0.27	435	266	12	22.30	0.04	12	c	n
114	4165	0.08	0.03	0.05	0.18	---	63	225	0.28	0.38	38		f
115	4185	0.11	0.02	0.17	0.17	---	155	155	1.00	0.11	18		f
116	4205	0.11	0.01	0.01	0.13	---	9	118	0.08	0.50	9		f
117	4225	0.22	0.03	0.06	0.24	---	27	109	0.25	0.33	14	c	f
118	4230	0.12	0.06	0.15	0.22	439	125	183	0.68	0.29	50		n
119	4235	4.25	2.26	16.66	0.56	431	392	13	29.75	0.12	53	c	n
120	4245	0.07	0.03	0.05	0.41	435	71	586	0.12	0.38	43		n
121	4255	0.24	0.02	0.07	0.26	---	29	108	0.27	0.22	8		f
122	4260	0.16	0.02	0.06	0.28	---	38	175	0.21	0.25	13		f
123	4265	0.10	0.01	0.08	0.21	---	80	210	0.38	0.11	10		f
124	4295	0.14	0.00	0.01	0.20	---	7	143	0.05	0.00	0		f
125	4325	0.87	0.10	0.11	0.25	362	13	29	0.44	0.48	11		HS2

HGS 94-44

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WELL NAME: #1 Alpine-Federal
ATTN: Steven Rauzi

ARIZONA GEOLOGICAL SURVEY

SAMPLE NO.	DEPTH (ft)	TOC AND ROCK-EVAL DATA				INTERPRETIVE RATIOS					NOTES		
		TOC	S1	S2	S3	TMAX	HI	OI	S2/S3	PI	S1/TOC	Check	Pyrogram
126	4355	0.12	0.01	0.03	0.27	---	25	225	0.11	0.25	8	c	f
127	4365	0.13	0.08	0.03	0.17	---	23	131	0.18	0.73	62		f
128	4375	0.22	0.11	0.03	0.17	---	14	77	0.18	0.79	50		f
129	4385	0.51	0.14	0.06	0.17	---	12	33	0.35	0.70	27	c	f
130	4395	0.27	0.07	0.02	0.20	---	7	74	0.10	0.78	26		f
131	4397	0.25	0.08	0.04	0.16	---	16	64	0.25	0.67	32		f
132	4402	0.14	0.07	0.05	0.20	---	36	143	0.25	0.58	50		f
133	4405	0.18	0.02	0.12	0.12	520	67	67	1.00	0.14	11		n
134	4409	0.23	0.03	0.06	0.16	---	26	70	0.38	0.33	13		f
135	4413	0.12	0.02	0.05	0.09	---	42	75	0.56	0.29	17		f
136	4415 Permian:	0.03	0.05	0.07	0.20	---	233	667	0.35	0.42	167		f
137	4425 Supai group	0.04	0.01	0.04	0.07	---	100	175	0.57	0.20	25		f
138	4428 Anos Wash fm	0.24	0.02	0.44	0.20	484	183	83	2.20	0.04	8	c	n
139	4435 (Big A Butte mbr)	0.13	0.11	0.10	0.15	351	77	115	0.67	0.52	85		ltS2
140	4445	0.13	0.01	0.07	0.14	---	54	108	0.50	0.12	8		f
141	4455	0.16	0.01	0.02	0.20	---	13	125	0.10	0.33	6		f
142	4485	0.17	0.00	0.18	0.19	---	106	112	0.95	0.00	0		f
143	4505 Total Depth	0.11	0.04	0.06	0.53	---	55	482	0.11	0.40	36		f

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* Tmax data not reliable due to low S2 values
TOC = weight percent organic carbon
S1, S2 = mg hydrocarbons/g rock
S3 = mg carbon dioxide/g rock
Tmax = Degree C

NOTES:
Check
c = sample analysis confirmed
Pyrogram
n = normal
f = flat (no peak)
ltS2 = low temperature S2 peak

HI = S2*100/TOC
OI = S3*100/TOC
PI = S1/(S1+S2)
S1/TOC = S1*100/TOC

Humble Geochemical Services

218 Higgins Street

Humble, Texas 77338

Phone 713 540-6050

AGS: #1 ALPINE-FEDERAL ORGANIC FACIES PLOT

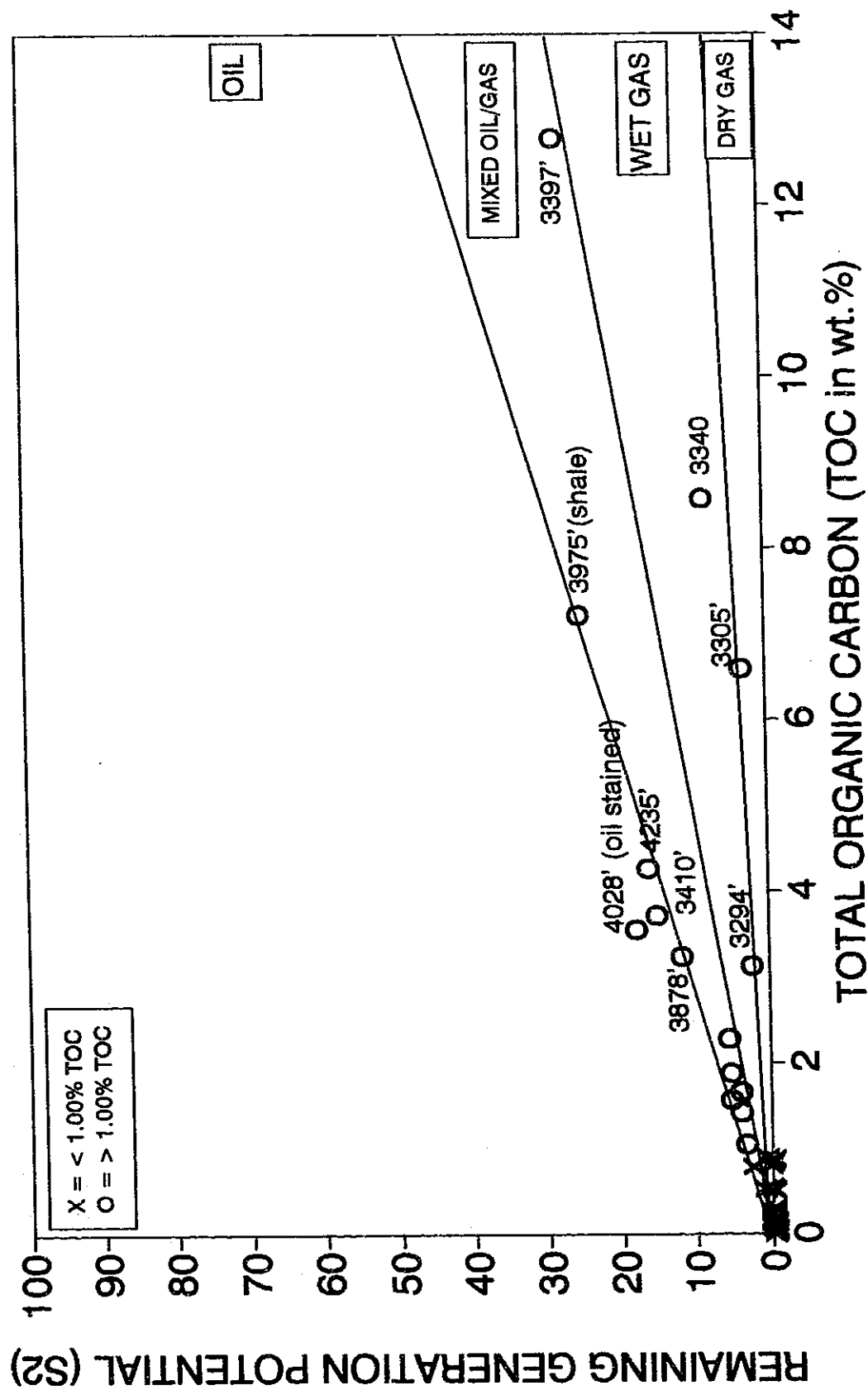
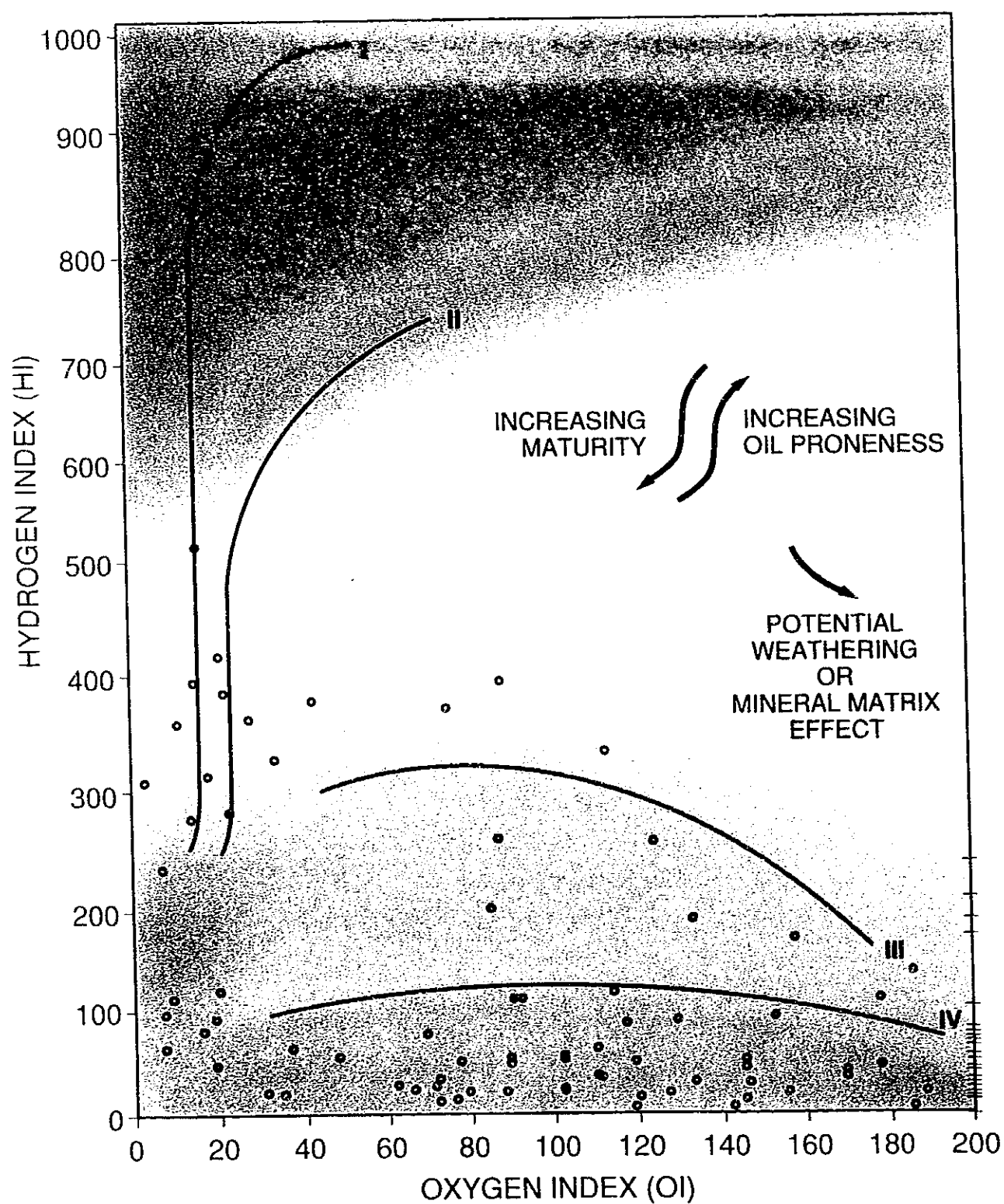


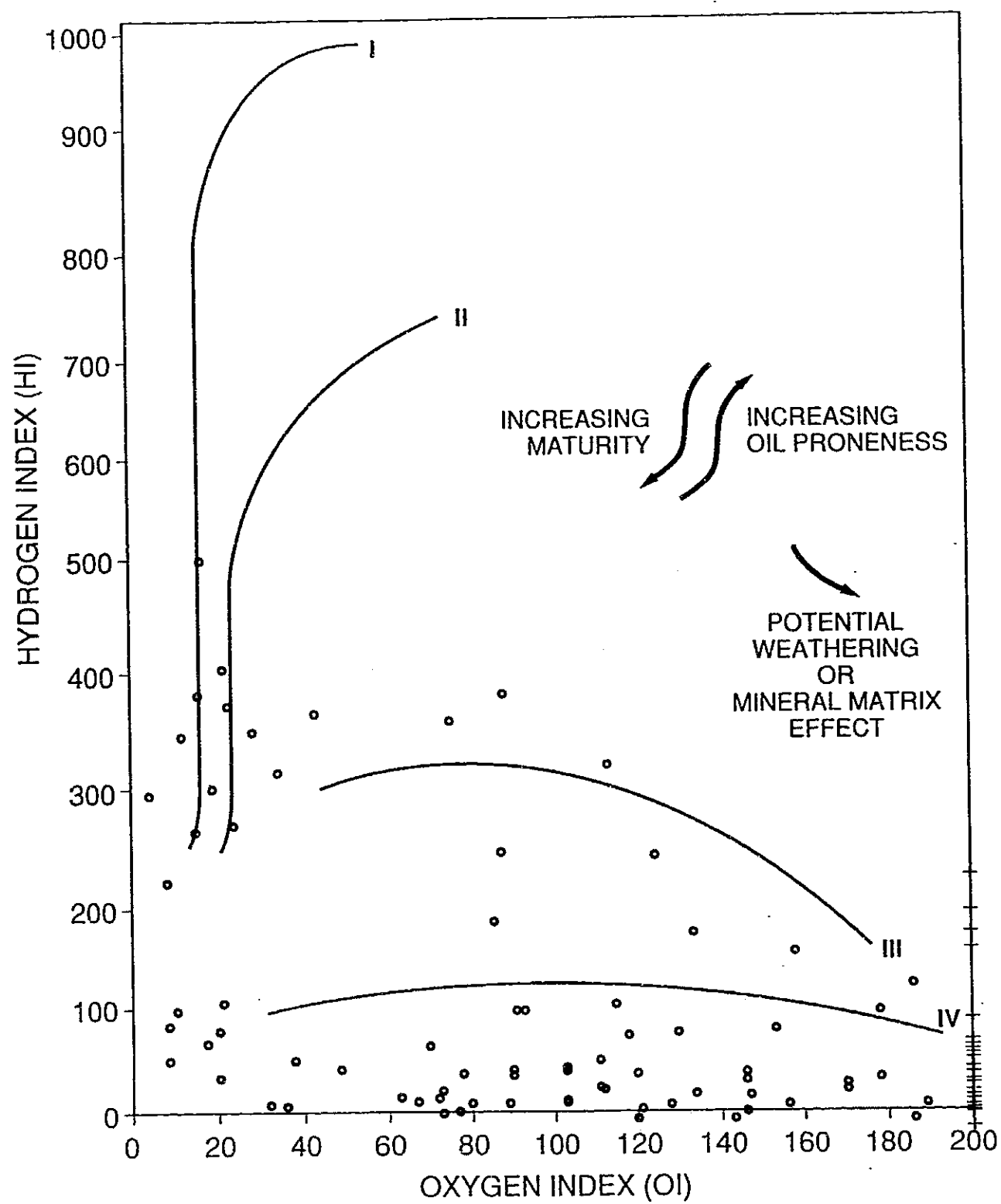
Figure 1

ARIZONA GEOLOGICAL SURVEY
NEW MEXICO STATE UNIVERSITY
#1 ALPINE-FEDERAL

KEROGEN TYPE PLOT

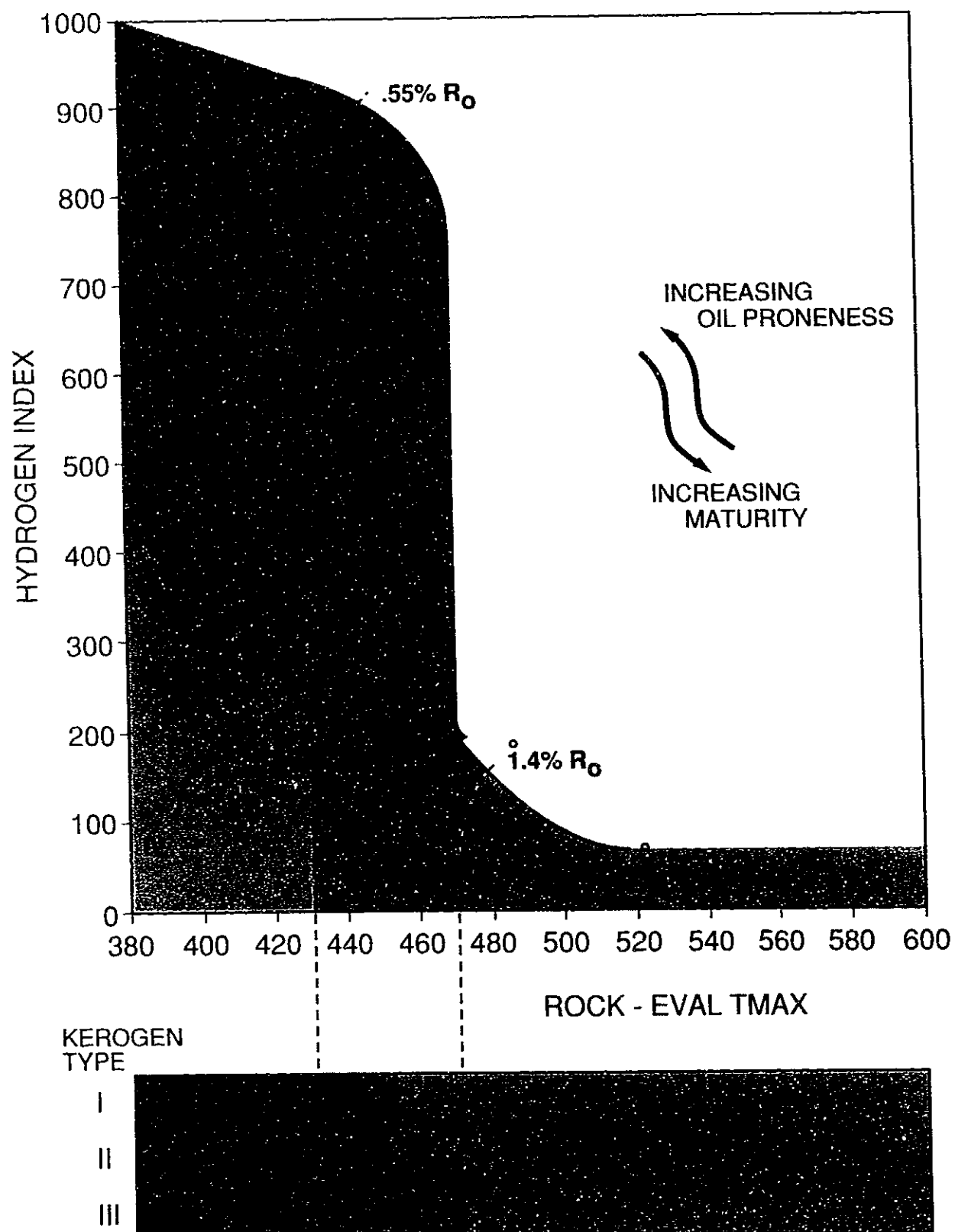


ARIZONA GEOLOGICAL SURVEY
NEW MEXICO STATE UNIVERSITY
#1 ALPINE-FEDERAL
KEROGEN TYPE PLOT

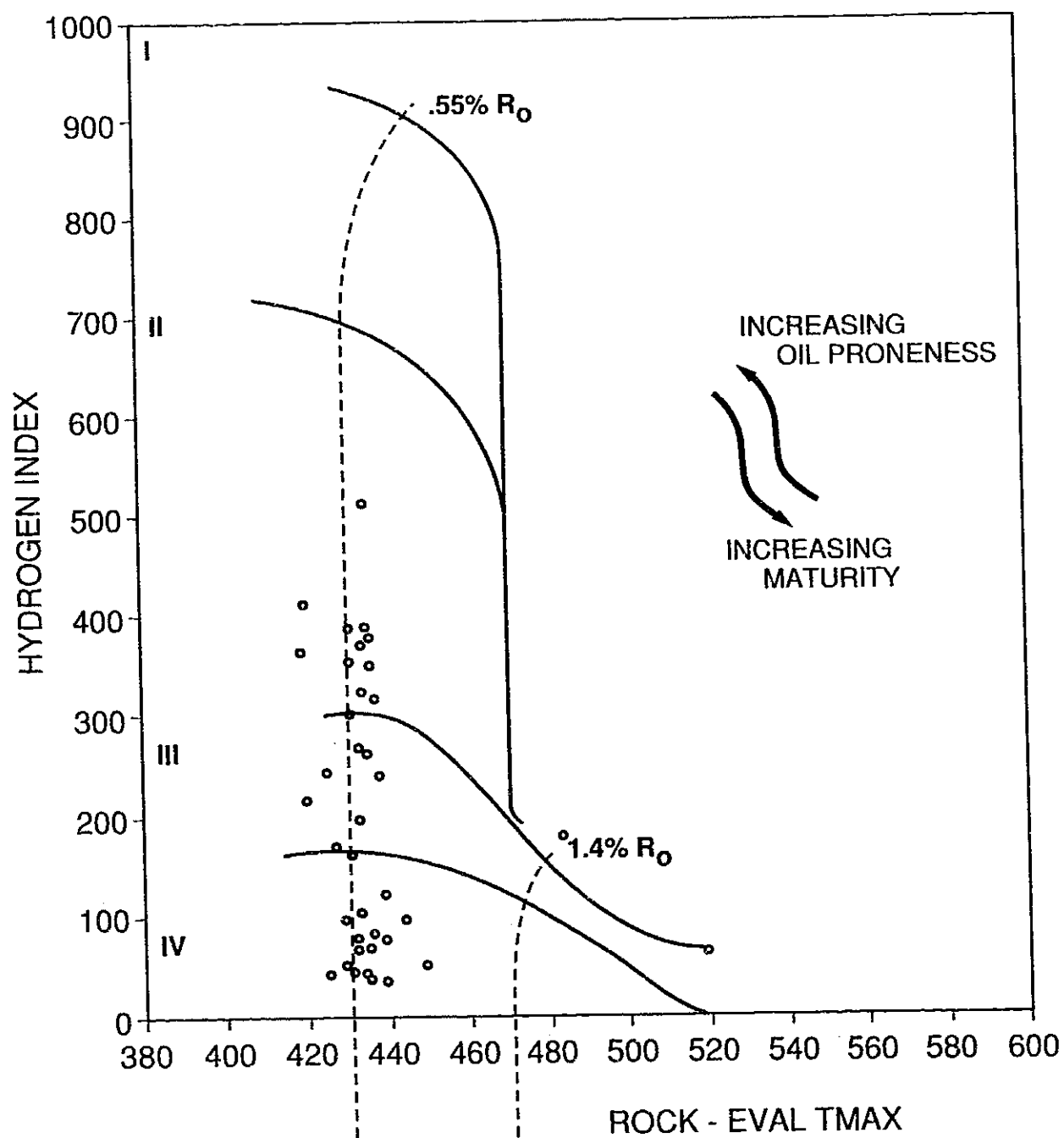


ARIZONA GEOLOGICAL SURVEY
NEW MEXICO STATE UNIVERSITY
#1 ALPINE-FEDERAL

KEROGEN TYPE AND MATURITY PLOT



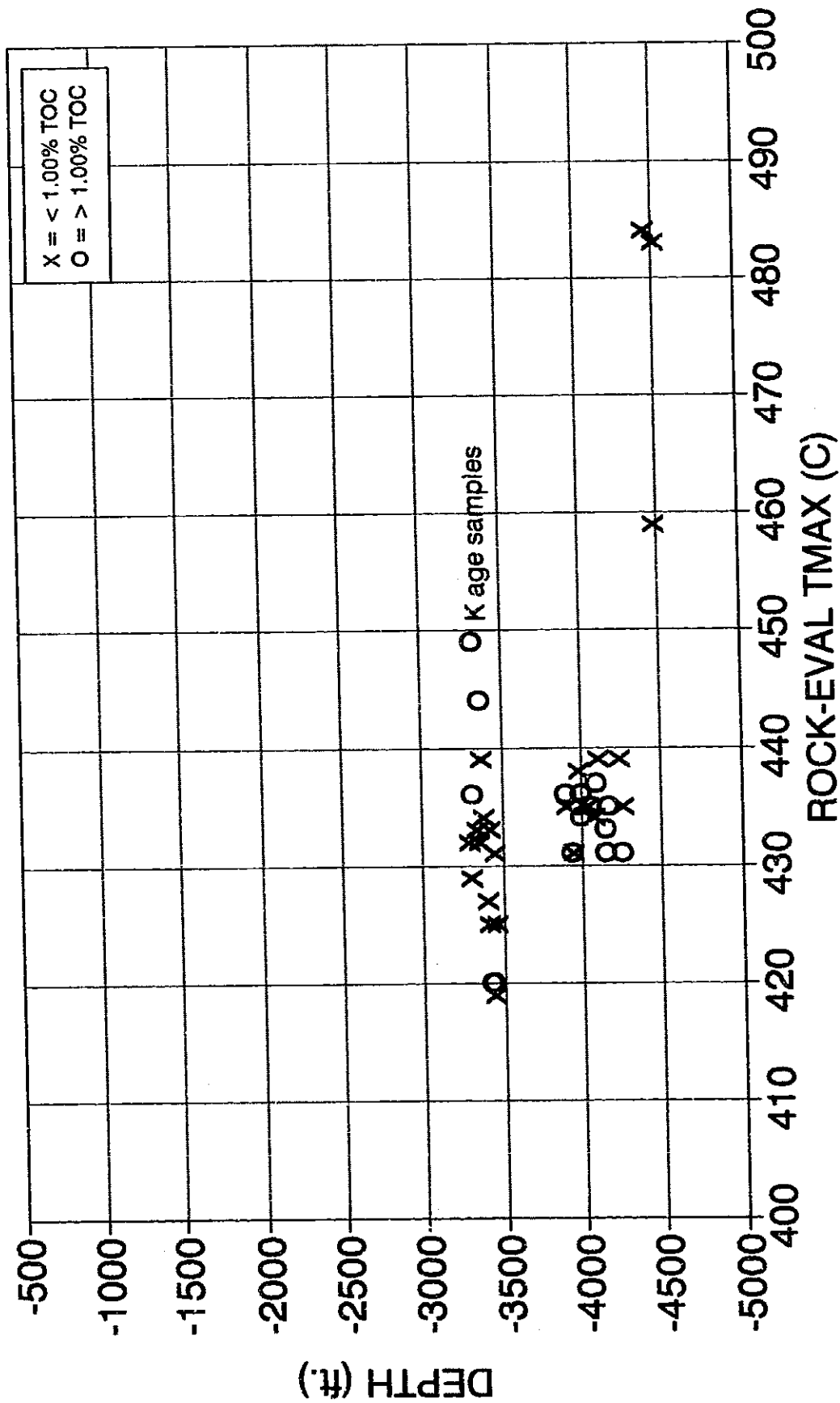
ARIZONA GEOLOGICAL SURVEY
NEW MEXICO STATE UNIVERSITY
#1 ALPINE-FEDERAL
KEROGEN TYPE AND MATURITY PLOT



KEROGEN
TYPE

I	IMMATURE	OIL	GAS
II	IMMATURE	OIL	GAS
III	IMMATURE	OIL	GAS

AGS: #1 ALPINE-FEDERAL DEPTH vs. THERMAL MATURATION



Well ID:1 ALPINE-FED.	Company:N.M. STATE U.	Ana. Date:MAY 10,1994
Project No:93B-64	Customer:ARIZONA G.S.	File Name:HIS1

Ana. Date: MAY 10, 1994

File Name: HIS1

[illegible]

HUMBLE GEOCHEMICAL SERVICES: GEOCHEMICAL LOG 2					
Well ID: 1 ALPINE-FED.		Company: N.M. STATE U.		Ana. Date: MAY 10, 1994	
Project No: 93B-64		Customer: ARIZONA G.S.		File Name: HIS1	
DEPTH	HI	OI	S2/S3	PC	PI
	HYDROGEN INDEX	OXYGEN INDEX	PETROLEUM TYPE	PYROLYZED CARBON	PRODUCTION INDEX
	(mg HC/g org.C)	(mg CO2/g org.C)	(mg HC/g rock)	weight %	S1/(S1+S2)
			DRY WET OIL GAS GAS	GOOD EXCEL POOR	SOURCE MIGRATED
	200 600	200 400	2.5 5.0	.3 1.5	0 1
504					
714					
904					
1114					
1314					
1534					
1750					
1953					
2164					
2364					
2560					
2754					
2966					
3255					
3294					
3340					
3380					
3410					
3465					
3585					
3755					
3815					
3865					
3915					
3975					
4015					
4060					
4105					
4145					
4225					
4255					
4325					
4385					
4405					
4425					
4455					

PAGE 3

**P/DWIGHTS PLUS DRILLING WIRE™
ROCKY MOUNTAIN REGION
Section II - 03/10/2000**

PAGE 3

REISSUES

FINAL CLASS: WF=UNSUCCESSFUL NEW FIELD WILDCAT; WFD=NEW FIELD DISCOVERY; WD=UNSUCCESSFUL DEEPER POOL WILDCAT; WDD=DEEPER POOL DISCOVERY; WS=UNSUCCESSFUL SHALLOW POOL WILDCAT; WSD=SHALLOW POOL DISCOVERY; WP=UNSUCCESSFUL NEW POOL DEVELOPMENT; WPD=NEW POOL DISCOVERY; WO=UNSUCCESSFUL WILDCAT OUTPOST; WOE=WILDCAT OUTPOST EXTENSION; D=UNSUCCESSFUL DEVELOPMENT; DO=DEVELOPMENT OIL WELL; DG=DEVELOPMENT GAS WELL;

PIN 878

ARIZONA/NEVADA

APACHE COUNTY

TONTO DRILLING SERVICES
1 ALPINE FEDERAL
API 02-001-90012

23-6N-30E
NE NW SW
2122 FSL 1153 FWL SEC
IC 020017000193

WILDCAT; 4500 PRE CAMBRIAN (FR:05/20/1993 DN WJK) LEASE
TYPE:FEDERAL; EL: 8556 GR LOCATION DATA: 3 1/2 MI N-NW ALPINE,
AZ NEAREST PRECAMBRIAN TEST SW NE 4-10N-24E; VERTICAL;

WF
D&A

CONTR: TONTO DRILLING, RIG # 1; SPUD:07/07/1993 CSG: 6 5/8 IN @ 20 W/4 SACK, 4 1/2 IN @ 500 W/40 SACK; LNR: 3 1/2 IN @ 2510-3369 W/22 SACK;
DRLG COMMENTS: AS OF DEPTH 4000 FT, TEST ENCOUNTERED ONLY, WTR, BHT APPROX 150F., OPR TO CONDUCT TESTS THRU OCT 1993 AT
WHICH, POINTWELL MAY BE TURNED OVER TO BLM FOR FURTHER, EVAL& POSSIBLE DEEPENING., LOCAL CALL(LOG): BASALTIC DIKE 3639., YESO
FORMATION CONTAINS TWO BASALTIC UNITS., PROBABLY DIKES, 100 FT THK UPPER, 60 FT THK, LOWER. TERTIARY UPPER 3751.; LOG TYPES: TM,
GR, NE: LOG TOPS: DAKOTA 3246, SAN ANDRES 3362, GLORIETA /SD/ 3436, YESO 3636, TERTIARY 3639, SUPAI 3751, FORT APACHE 4322; 4505 TD,
(FORT APACHE) (TD REACHED:08/29/1993) 4505 DTD COMP:09/01/1993 D&A; ; REISSUE TO ADD AND CORRECT DATA

**RIDGEWAY ARIZONA OIL
COMPANY**
10-26-29 RIDGEWAY STATE
API 02-001-20315

26-10N-29E
NW SW
2260 FSL 1206 FWL SEC

WILDCAT; 2300 FORT APACHE PERMIT: 903 (PMT APP'D 04/08/1997)
(FR:04/10/1997 FM KMS) LEASE TYPE:STATE TARGET OBJ: GAS; OPER
ADD: P O BOX 1110, ST. JOHNS, AZ 85936, (520)337-3230 EL: 6945 KB 6932
GR LOCATION DATA: 10 MI S UNNAMED FLD(FORT APACHE)CO2 DISC
3-11N-29E 12 MI NE SPRINGVILLE, AZ; VERTICAL;

WF
D&A-G

CONTR: AZTEC WELL SERVICING, RIG # 124; SPUD:04/18/1997 CSG: 8 5/8 IN @ 1098 W/600 SACK, 4 1/2 IN @ 3189 W/660 SACK; DRLG COMMENTS:
AZTECWS #157 COMPLETED.; LOG TYPES: CBND, POR, LITH; LOG TOPS: SAN ANDRES 880, GLORIETA /SD/ 1176, SUPAI 1400, FORT APACHE 2020;
SDWL # 001 FORT APACHE 1900-3118 1900 FT SLTSTN, DK RD-BRN, SHLY, DOLO CO2 1901 FT SS, MED GY, VFG, SRTD, SLI CALC, 1 UNIT CO2 CO2 1987
FT SLTSTN, MED GY-BRN, SDY SLI, DOLO W/ SMALL ANHY INCL CO2 2083 FT DOLO, MED GY-BRN, FN SUC, SHLY, SLTY W/ SCAT ANHY, INCL W/OCC
VUGS, 3 UNITS CO2 CO2 2156 FT DOLO, MED BRN-GY, FG-XLYN, BLK CARB INCL, SCAT VUGS, FRAC, 2 UNITS CO2 CO2 2176 FT DOLO, MED GY-BRN, F
SUC, SDY ABND, BLK CARB INCL, LG VUGS, CALC, 3 UNITS CO2 CO2 2188 FT SS, SLTSTN, DK-MED RD-BRN, SRTD, SLTY, 3 UNITS CO2 CO2 2200 FT
SLTSTN, MED RD-BRN, SFT, SHLY, SLTY SS, SLI CALC, 6 UNITS CO2 CO2 2201 FT SS, MED RD-BRN, VF-VFG, SOFT, SHLY, CALC, 3 UNITS CO2 CO2 2267
FT SS, MED GY, VFG, SRTD, FRACS, 6 UNITS CO2 CO2 2349 FT SS, DK RD-BRN, VFG, SUB ANG, WLL SRTD, HD, SH, SFT, DK RD-BRN, SDY, 14 UNITS CO2
CO2 2474 FT SS, MED- DK RD-BRN, VFG, VERT FRAC, SS LT GY, 8 UNITS CO2 CO2 2617 FT SS, DK RD-BRN, VFG, SLTY, NON-CALC, SMALL CLUSTERS OF
LT GY-GRN SHLY SS, 8 UNITS CO2 CO2 2712 FT SH, DK BRN-RD, SLTY, HD, VERT FRAC, 4 UNITS CO2 CO2 3038 FT WALLCAKE W/ LOST CIRC MATERIAL, 4
UNITS CO2 CO2 3082 FT CONGL, SH, DK BRN-RD, ABND QTZ GRS AND FELDS, 5 UNITS CO2 CO2 3096 FT WALLCAKE, SH, SFT, QTZ GRNS, SD GRNS, 5
UNITS CO2 CO2 3100 FT CONGL, DK RD-BRN MTX W/ CRS GRNS QTZ, 5 UNITS CO2 CO2 3115 FT CONGL, FN-PBBLE QTZ, SH DK BRN-RD, SLTSTN MATRIX,
OCC VUGS, FRACS, 5 UNITS CO2 CO2 3118 FT CONGL, SFT, WALLCAKE W/ ABND QTZ GRNS, FRACS, 5 UNITS CO2; 3202 TD, (FORT APACHE) (TD
REACHED:04/30/1997) 3202 DTD COMP:06/30/1998 D&A-G; ; NO DST RUN : REISSUE TO ADD AND CORRECT DATA

STATE: ARIZONA
COUNTY: APACHE
API: 02-001-90012
FIELD: WILDCAT
WELL CLASS: WF
TONTA DRLG SRVC

REISSUE

23-6N-30E
NE NW SW
2122 FSL 1153 FWL SEC
STATUS: D&A

?/N 878

1 ALPINE FEDERAL

SPUD: 07/07/1993 COMP: 09/01/1993 ELEV: 8556 GR
TD: 4505 (08/29/1993) FM/TD: FORT APACHE DTD: 4505
CONTR: TONTO DRILLING RIG # 1 (VERTICAL)
PROJ DEPTH/FM: 4500 PRE CAMBRIAN LEASE TYPE: FEDERAL

4505 DTD COMP: 09/01/1993 D&A; ; REISSUE TO ADD AND CORRECT DATA

LOCATION DATA: 3 1/2 MI N-NW ALPINE, AZ NEAREST PRECAMBRIAN TEST SW NE
4-10N-24E; ;
CASING: 6 5/8 IN @ 20 W/4 SACK, 4 1/2 IN @ 500 W/40 SACK; LINER: 3 1/2 IN @ 2510-3369
W/22 SACK;
LOG TYPES: TM, GR, NE;
LOG TOPS: DAKOTA 3246, SAN ANDRES 3362, GLORIETA /SD/ 3436, YESO 3636, TERTIARY

(OVER)

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03/03/2000

CARD# 0021-AZ

TONTA DRLG SRVC

API: 02-001-90012, 23-6N-30E

1 ALPINE FEDERAL

(CONTINUED)

3639, SUPAI 3751, FORT APACHE 4322;
DRLG COMMENTS: AS OF DEPTH 4000 FT, TEST ENCOUNTERED ONLY, WTR, BHT APPROX
150F., OPR TO CONDUCT TESTS THRU OCT 1993 AT WHICH, POINTWELL MAY BE TURNED
OVER TO BLM FOR FURTHER, EVAL& POSSIBLE DEEPENING., LOCAL CALL(LOG): BASALTIC
DIKE 3639., YESO FORMATION CONTAINS TWO BASALTIC UNITS., PROBABLY DIKES, 100
FT THK UPPER, 60 FT THK, LOWER, TERTIARY UPPER 3751.;

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03/03/2000

CARD# 0021-AZ



United States Department of the Interior

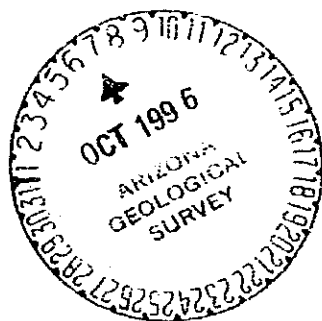
U.S. GEOLOGICAL SURVEY

30 OCT 96

Steve,

I hope this takes care of all the paperwork regarding this well. Sorry I didn't see you during the operation. Hope you had a great time on your Grand Canyon trip.

Cheers,
Fred



file 878



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

416 W. Congress, Suite 100
Tucson, Arizona 85701
(520) 770-3500



Larry D. Fellows
Director and State Geologist

August 15, 1996

Memo: Mr. Fred Grubb
USGS
2255 N. Gemini Drive
Flagstaff, Arizona 86001

From: *SLR* Steven L. Rauzi, Oil and Gas Program Administrator

Re: Tonto #1 Alpine Federal

The plugging forms we discussed today are enclosed. Send the application to plug and abandon per our previous discussions before starting work and the plugging record after the work is completed. Note the details of the plugging including the type of monument, etc. that we talked about today in part 2. I'll forward an approved copy of the application to P&A back to you before you start the work.

Let me know if I may be of further assistance.

Fred called to advise plans to move in Sept. 21st from SCC, start p+a Sept. 23. Forest Service prefers plate @ ground level as monument rather than 4' high 4" diameter pipe. Is okay with me as FS is surface management agency.

SLR

Fred Grubb called 9/19/96: Tonto to drive down Monday & rig up Wed 9/25. Has reviewed & revised P&A plan w/ John Haas to bring plug from stub to shoe.

Visual Kerogen Assessment
Vitrinite Reflectance



Integrated Color Analysis
Fluorescence

GEO-SCAN, INC.

file 878

May 17, 1996

Dr. Steve L. Rauzi
Arizona Geological Survey
416 W. Congress, Suite 100
Tucson, Arizona

Dear Steve:

Sorry that the report took so long but I am glad to hear that you like the results. The Arizona Geological Survey has my permission to publish and/or reprint the data and sell it if they so wish. This includes the text-figures and the 35mm slides. If you want to rewrite the text, that's fine with me.

When time and money permit, I'll start looking at the rest of the samples. As to when that might be, I can't say for sure. As I mentioned in my last letter, consulting work has been extremely slow and it doesn't look as though things are going to turn around any time soon ----- perhaps around election day if we're lucky. I sincerely hope that the thermal maturity data that I put together on the No. 1 Alpine-Federal well will be useful in gaining a better understanding of the Upper Cretaceous in eastern Arizona.

Best regards,

Karl W. Schwab
Karl W. Schwab





Fife Symington
Governor

State of Arizona
Arizona Geological Survey

416 W. Congress, Suite 100
Tucson, Arizona 85701
(520) 770-3500



Larry D. Fellows
Director and State Geologist

May 15, 1996

Mr. Karl W. Schwab
Geo-Strat, Inc.
1718 Triway
Houston TX 77043

file 878

Dear Mr. Schwab:

This will acknowledge receipt of your letter of May 6 and *Contributed Report* on the organic and thermal maturity analyses of Upper Cretaceous sediments in the 1 Alpine Federal well. We appreciate your contribution to the study and understanding of Cretaceous rocks in Arizona. One last formality, we will need a short letter granting us permission publish the report in our *Contributed Report Series*, a list of which is enclosed for your information.

Again, on behalf of the Oil and Gas Commission and the Geological Survey, thank you for the *Contributed Report*.

Sincerely,

Steven L. Rauzi

Steven L. Rauzi
Oil & Gas Program Administrator

Visual Kerogen Assessment
Vitrinite Reflectance



Integrated Color Analysis
Fluorescence

ONE-STOP, INC.

May 6, 1996

Dr. Steven L. Rauzi
Oil and Gas Program Administrator
Arizona Geological Survey
416 W. Congress, Suite 100
Tucson, Arizona 85701

file 878

Dear Steve:

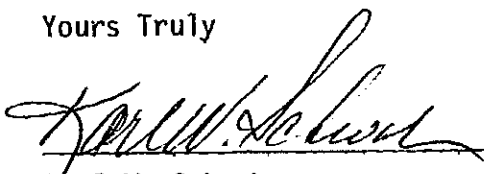
I am sorry that this project has taken me so long but its just been impossible for me to get to it on a full time basis. I have been working as a substitute teacher at one of the local High Schools here in Houston because there is essentially no thermal maturity work (consulting) to be had.

Hopefully, the data that I have generated will have made it worth the wait. Enclosed is a copy of my report along with all the hard data. Also you should find a copy of my diskett that contains the text. The paper is written in Claris Works 4.0 on a Power Mac. I enclosed the diskett just in case you want to change things around (fonts, style, size, etc.). Please find several 35 mm slides showing what I believe to be the nannofossil ?Bukryaster (Discoaster) hayi. To my knowledge, this is the first report of nannofossils from the Upper Cretaceous of eastern Arizona. According to the literature, this form is restricted to the Early Campanian. I however, gave myself a little latitude and refer to the stratigraphic section as ranging from ?Santonian to Campanian in age ----- assuming my identification is correct.

It is possible that there is a couple of minor unconformities within the Upper Cretaceous section (based on variations in the kerogen indices), but I can't be sure. The changes may only reflect a change in the lithology and/or environment of deposition. Regardless, the Upper Cretaceous in the No. 1 Alpine-Federal well needs to be examined in greater detail in order to get a better fix on the time-stratigraphic setting.

Once again, I apologize for the delay in getting this data to you. I sincerely appreciate your patience and understanding.

Yours Truly


Karl W. Schwab

5-2-96 Fred Grubb, USGS called: Is busy logging wells at Taft Calif. Plan is to P+A Toronto hole 2nd Half May or 2nd Half July. Expects return call from Toronto Dtls in next week or so.

556-7183

7-17-96 call + leave msg on Fred Grubb voice mail about time frame for plugging Alpine hole. Is 2nd half July still valid or is there a new target date. Ask him to return call + let me know.

7-26-96 Fred Grubb calls - All Toronto crews working until Sept. plan to P+A well between Sept. 1 + 30. Will cmt across stubb and up to surface.

ARIZONA GEOLOGICAL
SURVEY

416 W. CONGRESS, SUITE 100, TUCSON, AZ 85701

FAX

State of Arizona
Arizona Geological Survey
416 W. Congress, Suite 100
Tucson, Arizona 85701
(520) 770-3500



Larry D. Fellows
Director and State Geologist

Date: 3-26-96

Number of pages including cover sheet: 2

To: John Haas

BLM

Phone:

Fax phone: 602-650-0556

CC:

From: Steve Rauzi

Phone: (520) 770-3500

Fax phone: (520) 770-3505

REMARKS: ☐ Urgent ☒ For your review ☐ Reply ASAP ☐ Please comment

2-15-96

John Sass, letter about plugging
the Tonto Geothermal observation
hole

it also constrains models for the Cenozoic uplift of the Plateau.

T42E-4 1330h POSTER

Heat Flow and Cenozoic Geodynamics of the Southwestern Colorado Plateau

Paul Morgan (Department of Geology, Northern Arizona University, Flagstaff, AZ, 86011-4099; ph. 520-523-7175; e-mail: morgan@unkar.glg.nau.edu); John H. Sass; Frederick V. Grubb (U. S. Geological Survey, 2255 North Gemini Drive, Flagstaff, AZ, 86001; ph. 520-556-7226 or 7183; e-mail: jsass or fgrubb@iflag2.wr.usgs.gov); Colin F. Williams (U. S. Geological Survey, 342 Middlefield Road, Menlo Park, CA 94025; ph. 415-329-4881; e-mail: colin@hq.wr.usgs.gov)

file 878
Early models of uplift and stability of the Colorado Plateau focussed on data suggesting low to moderate heat flow (50-60 mW m⁻²) in the interior of the plateau. Many data, however, including two new heat flow values from deep wells in the south and western plateau indicate a complex thermal regime in the plateau, inconsistent with one-dimensional or even two-dimensional thermo-mechanical models of plateau geodynamics. The two new heat flow values come from a 1373 m deep well near Alpine, Arizona (33° 54'N, 109° 09'W), and from a 1500 m deep well in the Kaibab Uplift, north of the Grand Canyon (37° 57'N, 112° 21'W), which yield best heat flow values of 86 and 49 mWm⁻², respectively. These data confirm that although some shallow heat flow values may reflect a thermal regime modified by groundwater convection (e.g., the San Francisco volcanic field), other variations in heat flow across the plateau may have a deeper origin. Of particular interest is the observation that one of the largest "non-volcanic" swells on the plateau, the Kaibab uplift, is characterized by low heat flow in contrast to high heat flow in the comparable elevation "volcanic" swell of the Springerville volcanic field. Thermal and isostatic models that are consistent with these observations and the Mesozoic/Cenozoic geologic and tectonic evolution of the southwestern US include significant and heterogeneous pre-Neogene tectonic thickening of the Colorado Plateau crust and/or Neogene volcanic and phase-change thickening of the crust.



United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Geothermal Studies Project
2255 North Gemini Drive
Flagstaff, Arizona 86001
jsass@flagmail.wr.usgs.gov

February 15, 1996

Steven L. Rauzi
Oil and Gas Program Administrator
Arizona Geological Survey
416 W. Congress, Suite 100
Tucson, AZ 85701

file 878

Dear Steve:

Thanks for your letter of February 9. Alas, there's no Federal interest of which I am aware to deepen the Alpine well, even as a funds match to private or State sources.

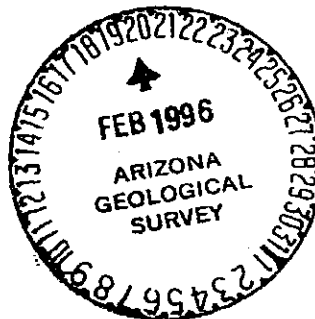
That being the case, we'll proceed to plug and abandon the well sometime this spring or summer. We've concluded our heat-flow studies. They were presented as part of a poster at the Fall American Geophysical Union meeting. The details will be published as a USGS Open File Report later this year.

As for details of our P&A, Fredd Grubb of our Flagstaff Office will be in charge of arrangements. Once we have a firm bid, the procurement will be handled by DOE's Albuquerque office.

Thanks for your help and your interest.

Yours sincerely,

John H. Sass
Geophysicist



cc Jim Dieterich
Fredd Grubb
Gladys Hooper
Dale Nations
Dan Sanchez
Bob Tilling
Colin Williams
Jim Witcher



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

416 W. Congress, Suite 100
Tucson, Arizona 85701
(520) 770-3500



Larry D. Fellows
Director and State Geologist

February 16, 1996

Mr. Karl Schwab
Geo-Strat, Inc.
1718 Triway
Houston TX 77043

file 878

Dear Mr. Schwab:

I am again writing to ask about the status of your analysis of the #1 Alpine core that you sampled in July 1995, and which we talked about in early January of this year. I got the impression from our conversation in January that you would be sending some text and slides about your analysis of the Cretaceous strata. Your conclusions are valuable because the Alpine hole fills a large gap in available data on Cretaceous and Permian strata in east-central Arizona.

I was hoping to provide the Oil and Gas Commission with a report about your work in its February 9 meeting. I now hope to provide something in the Commission's next meeting on May 17. It would be appropriate to provide them with something at that time.

In the meantime, however, we continue to look forward to your analysis, and, as we discussed, are anxious to advertise and offer your report in our *Contributed Report Series*.

Sincerely,

Steven Rauzi

Steven L. Rauzi
Oil & Gas Program Administrator

I called Karl May 1 & left inquiry on phone msg. machine.

F A X to: Fred Grubb, USGS Flagstaff
Fax No. 520-556-7169

2 pages total

phone 556-7183
From: Steve Rauzi, Arizona Geological Survey
Phone 520-770-3500, Fax 520-770-3505

file 878

Date: February 16, 1996

Thank you for calling this morning to discuss the geothermal hole near Alpine. A copy of our rule on plugging methods and procedures, R12-7-127, is attached. Let me know if I may be of further assistance.

John Haas's phone number in Phoenix is 602-650-0222.

Hope's to pta well by May or so.

**Arizona Administrative Code Title 12, Chapter 7
Oil and Gas Conservation Commission**

R12-7-127. Plugging methods and procedures

A. Before abandoning any well, the operator shall submit an application to plug and abandon to the Commission for approval as required in R12-7-126. All down-hole plugging shall be conducted through drill pipe or tubing, unless otherwise approved by the Commission.

B. Open hole

1. A cement plug shall be placed to extend at least 50 feet below the bottom, except as limited by total depth or plugged back total depth, to 50 feet above the top of any zone containing fluid with a potential to migrate, any zone of lost circulation, and any zone containing potentially valuable minerals, including noncommercial hydrocarbons, coal, and oil shale.

2. All freshwater zones shall be plugged with a continuous cement plug which shall extend from at least 50 feet below to at least 50 feet above the freshwater zone, or a 100-foot plug shall be centered across the base of the freshwater zone and a 100-foot plug shall be centered across the top of the freshwater zone.

3. Open hole below the shoe of cemented casing shall be plugged with cement which shall extend from at least 50 feet below to at least 50 feet above the shoe.

C. Cased hole

1. A cement plug shall be placed opposite all open perforations and extend to a minimum of 50 feet below, except as limited by total depth or plugged back total depth, to 50 feet above the perforated interval. In lieu of the cement plug, a bridge plug may be placed within 50 to 100 feet above the open perforations and followed by at least 50 feet of cement.

2. If any casing is cut and recovered, a cement plug shall be placed to extend at least 50 feet above and below the stub.

3. No annular space that extends to the surface shall be left open to the drilled hole below. If this condition exists, a minimum of the top 100 feet of each annulus shall be plugged with cement.

D. Plugging mud having the proper weight and consistency to prevent movement of other fluids into or within the bore hole shall be placed across all intervals not plugged with cement. In the absence of other information at the time plugging is approved, plugging mud shall be made up with a minimum of 15 pounds per barrel of sodium bentonite and a nonfermenting polymer, have a minimum consistency of 9 pounds per gallon, a minimum viscosity of 50 seconds per quart, and mixed with fresh water.

E. A cement surface plug of at least 50 feet shall be placed in the smallest casing which extends to the surface. The top of this plug shall be placed as near the eventual casing cut-off point as possible.

F. The abandoned well shall be marked by a piece of metal pipe not less than four inches in diameter securely set in cement and extending at least four feet above the general ground level. The well location and identity shall be permanently inscribed as required in R12-7-106(A). An abandoned well location on tilled or otherwise unique land shall be marked in a manner approved by the Commission.

G. The drill site of an abandoned well shall be restored as nearly as possible to its natural state, to the satisfaction of the Commission. All pits shall be filled and all equipment and debris shall be removed from the location.

H. The operator shall notify the Commission at least 48 hours before starting abandonment operations to allow a representative of the Commission to witness the operations required in this Section. To ensure the integrity or placement of any plug, the representative may order the plug to be tested.

I. Within 15 days after the plugging of any well, the operator shall file with the Commission a plugging record setting forth in detail the method used in plugging the well, including the casing record; the size, kind, and depth of plugs used; and the name and depth interval of each formation containing fresh water, oil, gas, or geothermal resources.



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

416 W. Congress, Suite 100
Tucson, Arizona 85701
(520) 770-3500



Larry D. Fellows
Director and State Geologist

February 9, 1996

file 878

Mr. John H. Sass
U.S. Geological Survey
2255 N. Gemini Drive
Flagstaff, AZ 86001

Dear John:

The Oil and Gas Conservation Commission continues to be interested in the geothermal-observation hole near Alpine. Dale Nations asked me about it in today's meeting of the Commission.

That is why I am writing to ask about the status of your work on this project. Do you still feel the hole will be deepened to Precambrian rocks?

I want to update the Commission in its May 17 meeting in Phoenix, and would appreciate any information you would be kind enough to provide, especially about any published or soon to be published results. Of course, you are most welcome if you wish to attend the May 17 meeting. I do look forward to hearing from you soon.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

416 W. Congress, Suite 100
Tucson, Arizona 85701
(520) 770-3500



Larry D. Fellows
Director and State Geologist

December 21, 1995

Mr. Karl Schwab
Geo-Strat, Inc.
1718 Triway
Houston TX 77043

file 878

Dear Karl:

Since I have not heard from you since you were in Tucson last summer, I thought I should write and ask about the status of your analysis of the #1 Alpine core that we sampled when you were here. We continue to look forward to the results of your analysis, and, as we discussed, are anxious to advertise and offer your report to industry and the public in our *Contributed Report Series*.

Please let me know if there is any further information we may provide, and, in the spirit of the season, merry Christmas and happy new year.

Sincerely,

Steve Rauzi

Steven L. Rauzi
Oil & Gas Program Administrator

Called January 10, 1996 - Has interesting results at odds with published dates of Cretaceous strata in region per Nation's work. Will call Dale. Will send some text and slides on analysis of Cretaceous strata. Hasn't gotten around to study of pre Cretaceous strata because of interesting results of Cretaceous study.

SOUTHWEST TECHNOLOGY DEVELOPMENT INSTITUTE

Box 30001, Department 3SQL
Las Cruces, New Mexico 88003-8001
Telephone: (505) 646-1846
Telefax: (505) 646-2960



30 January, 1995

Dr. Larry D. Fellows
Director/State Geologist
Arizona Geological Survey
845 North Park, Suite 100
Tucson, Arizona, 85719

file 878

Dear Larry:

I am pleased to send a complete photographic record of the core from the Alpine 1/Federal borehole to the Arizona Geological Survey for archiving and future study. Included with the slides is a listing of footage's for each photograph and a logging guide which contains an explanation of the markings on the core.

As you are aware, the Alpine project, as negotiated by the State of Arizona and Tonto Drilling, did not provide for the core photography. The color slides that I'm sending are through the courtesy of New Mexico State University. You are free to make reproduction of the slides and to redistribute to researchers.

I wish you and the Arizona Geological Survey continued success. Also, I send my condolences on the recent death of Wes Peirce.

Sincerely,

James C. Witcher
James C. Witcher
Geologist

cc Rudi Schoenmackers, Director SWTDI/NMSU
Danny Sanchez, U. S. DOE/Albuquerque



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

January 19, 1995

Daniel M. Jarvie, President
Humble Geochemical Services
P. O. Box 789
Humble, Texas 77347

Dear Dan:

This will acknowledge receipt of your final geochemical report on the 1 Alpine-Federal hole in east-central Arizona. As noted in my letter of October 18, 1994, the Arizona Geological Survey will make this report available in its "Contributed Report" series.

I also wish to thank you, on behalf of the Commission and the Survey, for taking the time and effort necessary for putting together such a fine report.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator



Humble Geochemical Services

Division of Humble Instruments & Services, Inc.

P.O. Box 789 • Humble, Texas 77347

218 Higgins Street • Humble, Texas 77338

TELEPHONE: (713) 540-6050

FACSIMILE: (713) 540-2864

Geochemical Services for Exploration, Development and Production

January 11, 1995

Steven L. Rauzi
Arizona Geological Survey
845 North Park
Suite #100
Tucson, AZ 85719

Dear Dr. Rauzi:

Enclosed is an unbound original and a bound copy of the report I have written on the 1-Alpine Federal well. We completed additional analyses and merged these results into a final interpretive report. I realize the GC traces take up considerable space and they could be reduced to four or perhaps even 8 per page. We can import the plot files from these GC runs into a word processor but it does reduce the resolution of the output. In any case they are submitted as is to save any further delays in sending you the report.

We provided both color and black/white kerogen typing plots so if you need to make additional copies the B/W are better.

I hope you find the report useful and please contact me if you have any questions.

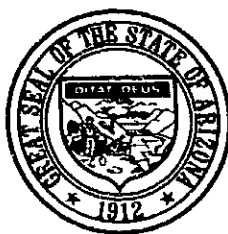
I appreciate your patience in delivery of this report, and hope we have some additional cooperative efforts in the future. Also, thanks for you letter during the floods here last fall. Even though we were not directly affected by it, I appreciated your concern.

Best regards and best wishes for 1995!

Sincerely,

Daniel M. Jarvie

DMJ/cb



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

October 18, 1994

Daniel M. Jarvie, President
Humble Geochemical Services
P. O. Box 789
Humble, Texas 77347

Dear Dr. Jarvie:

Since it has been several months since we have discussed your analysis of the core from the 1 Alpine Federal well in east-central Arizona, I thought I should write and ask about the status of your final report. The Arizona Geological Survey has a "contributed report series" and we would like to advertise and offer your final report to the public in this series. We would, of course, refer any specific geochemical inquiries to you.

Along these lines and as a result of contacts made at the annual A.I.P.G. meeting in Flagstaff last week, I am sending a copy of your preliminary report to Thomas Kenneth (T.K.) Reeves, Jr., BDM Oklahoma. They are examining the oil and gas potential in the Black Mesa basin in particular and northeastern and east-central Arizona in general for the U.S. Department of Energy and in discussing the 1 Alpine hole expressed an interest in the geochemical work that you have done.

I do look forward to hearing from you at your earliest convenience.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795

July 18, 1994



Larry D. Fellows
Director and State Geologist

Mr. Larry Pisto
Manager, Core Division
Tonto Drilling Services, Inc.
P. O. Box 25128
Salt Lake City, Utah 84120-0128

Re: Tonto Drilling Services, Inc. Alpine #1, State Permit No. 878
Performance Bond No. 115574
The Insurance Company of the State of Pennsylvania

Dear Mr. Pisto:

Our records indicate that Tonto Drilling Services has submitted all of the forms and information on the referenced well that are required by this office and that the U.S. Geological Survey has assumed responsibility for the well including its final plugging and abandonment.

As a result, this letter will serve as the written permission of the **Oil and Gas Conservation Commission** of the State of Arizona to cancel the referenced bond.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosure

TONTO
DRILLING SERVICES, INC.

P.O. Box 25128
2200 South 4000 West
Salt Lake City, Utah 84120-0128
Telephone: (801) 974-0645 Fax: (801) 973-2994

July 13, 1994

Mr. Steve Rauzi
Arizona Dept. of Oil and Gas
Arizona Geological Survey
845 North Park Avenue, Suite 100
Tucson, Arizona 85719

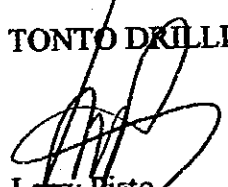
Dear Mr. Rauzi:

As our contract is now completed, we request that you return the original bond to us so that we can cancel with our bonding company.

Thank you for your assistance.

Regards,

TONTO DRILLING SERVICES, INC.


Larry Pisto
Manager, Core Division

LP:jm



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795
July 12, 1994



Larry D. Fellows
Director and State Geologist

John H. Sass
U.S. Geological Survey
2255 North Gemini Drive
Flagstaff, Arizona 86001

Dear John:

Information on the Shields well that we talked about this afternoon is in the public domain. I will telecopy the completion report for this well to you after I write this note. Formation tops and general lithology as reported by the operator are on the form.

With respect to the Alpine geothermal well, several individuals and companies interested in the oil shows in this well have made inquiries with this office as to the current status of the well. Its too bad a sample cannot be easily collected from the top of the fluid column behind the drill rod. In light of the bleeding oil in the core at about 4,025 feet, there may very well be a film of live oil at the top of that fluid column.

Also with respect to the Alpine hole, a copy of my recent open-file report on the oil shows in the hole, a copy of the preliminary geochemical report on the core from that hole, and several photographs of the bleeding oil at about 4,025 feet are enclosed.

Do not hesitate to contact us if we can be of any assistance as your project on the geothermal hole near Alpine progresses.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosure



ARIZONA

Department of Commerce

Fife Symington
Governor of Arizona

Sara Goertzen
Director

June 22, 1994

Mr. Nyles D. Lackey, Program Manager
United States Department of Energy
Albuquerque Field Operations Office
P.O. Box 5400
Albuquerque, NM 87185

SUBJECT: TWO COPIES OF THE FINAL REPORT FOR THE ALPINE-
SPRINGERVILLE GEOTHERMAL GRANT NO. DE-FG04-91AL73394

Dear Nyles:

The Arizona Geothermal Project is now completed and the Final Report of the field work has been reviewed by the Arizona Geological Survey and the Arizona Department of Commerce and accepted. Therefore, the Department of Commerce's Energy Office is hereby submitting to DOE two copies of the Final Report for your records.

In addition, the Energy Office and the Arizona Oil and Gas Conservation Commission have agreed to allow the USGS to assume responsibility for the Alpine 1/Federal borehole and for the USGS to operate it as an observation well.

With this, the Arizona Department of Commerce considers all work covered under GRANT NO. DE-FG04-91AL73394 to be now completed.

The Arizona Department of Commerce is proud to be a part of this geothermal project for DOE and the State-of-Arizona and we can all be proud of the excellent work Jim Witcher, the Chief Geologist for the project, and Dr. John Sass of the USGS have done.

Sincerely,

Frank P. Mancini Ph.D., P.E.
Energy Office

**AZ OIL & GAS
CONSERVATION COMMISSION**

JUN 27 1994

C: Pam Paschal, Contracts Manager

878



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

June 7, 1994

Mr. Carl Livingston, Chairman
Catron County Commission
P. O. Box 507
Reserve, New Mexico 87830

Dear Chairman Livingston:

I read your good letter in the June 1994 issue of *Governing* magazine. Even though I do not recall reading the article to which your letter referred, I agree with the points your letter raised and clarified.

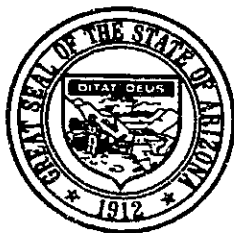
The main reason I am writing, however, is to send a gratis copy of our Open-File Report 94-1, *Implications of Live Oil Shows in Eastern Arizona Geothermal Test* and an article on the geothermal test from the January 3, 1994, issue of *Oil & Gas Journal*. Since the geothermal test has implications for western Catron County, as well as eastern Arizona, I was prompted to bring this information to your attention after reading your letter.

By the way, I drove to Reserve to have dinner one evening when I was in Alpine last summer to witness certain operations on the Alpine hole. Let me take this opportunity to say that I had a very good Mexican meal at the restaurant on the main corner as one comes into Reserve from the west.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosures



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

May 27, 1994

Daniel M. Jarvie, President
Humble Geochemical Services
P. O. Box 789
Humble, Texas 77347

Dear Dr. Jarvie:

As a follow-up to my telephone call awhile back, I have enclosed three articles that discuss the igneous reservoir rock at the Dineh-bi-Keyah oil field. As I noted in my phone call, because of production from igneous rocks at Dineh-bi-Keyah, I am intrigued with the igneous rocks in close proximity to high TOC and early to mid oil window source rocks in the 1 Alpine-Federal hole. That's why I was wondering if it was possible to determine the relative contribution of volcanism to the maturity level of the potential source rocks in the Alpine hole and if it was possible to even determine this from the information we currently have at hand.

The enclosed articles include (1) Pohlmann, 1967, (2) McKenny and Masters, 1968, and (3) Reynolds, 1986 (see enclosed list of selected Dineh-bi-Keyah articles). Please note pages 64-67 in Pohlmann and pages 2050-2051 in McKenny and Masters. McKenny and Masters, 1970, add nothing new to their discussion of 1968.

I believe your preliminary geochemical report confirms the presence of hydrocarbon source rocks in the Alpine hole. It records several albeit thin zones with significantly high amounts of total organic carbon. In addition, Permian rocks in the early to mid oil window in the Alpine hole further confirms that the volcanism in east-central Arizona and west-central New Mexico has not been detrimental to the source-rock potential of these units. I do not, however, believe that igneous reservoir rocks are a requirement to commercial accumulations of oil or gas in this region but I do believe that commercial accumulations of oil and gas, including accumulations similar to Dineh-bi-Keyah, could very well still be sleeping in this region.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosures



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

May 25, 1994

Mr. Roger P. Slayton, President
Mountain States Petroleum Corp.
P. O. Box 1936
Roswell, New Mexico 88201

Dear Mr. Slayton:

I recently received word that Mountain States Petroleum Corporation has purchased Kerr McGee's interest in the Dineh-bi-Keyah Field on the Navajo Nation of northeastern Arizona. On behalf of the **Oil and Gas Conservation Commission** of the State of Arizona let me take this opportunity to welcome you to the State of Arizona. We truly hope that your operations in Arizona are profitable.

Since you have bought Dineh-bi-Keyah Field, a unique field that has produced over 17.5 million barrels of oil from an igneous reservoir rock, I am taking the liberty of enclosing an article on an interesting geothermal test from the January 3, 1994, issue of *Oil & Gas Journal*, a Preliminary Geochemical Report on that well, and a flyer on Open-File Report 94-1, *Implications of Live Oil Shows in Eastern Arizona Geothermal Test*. Just for good measure, I have also enclosed a few photographs of the bleeding oil show (indicating rock is tight, a source not reservoir rock) at about 4,028 feet in the Alpine hole.

In my opinion, the geochemical analysis confirms the presence of hydrocarbon source rocks as postulated in the *OGJ* article. It records several albeit thin zones with significantly high amounts of total organic carbon. In addition, Permian rocks in the early to mid oil window in the Alpine hole further confirms that the volcanism in east-central Arizona and west-central New Mexico has not been detrimental to the source-rock potential of these units. Doesn't it seem likely, therefore, that commercial accumulations of oil and gas, including accumulations similar to Dineh-bi-Keyah, could very well be sleeping in this region?

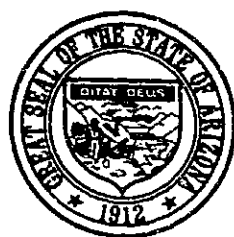
Sincerely,

Steven L. Rauzi

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosures

P.S.
Please feel free to
contact Humboldt Geochemical
Services directly if you have
any questions or comments on
the preliminary geochemical
report. SLR



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

May 23, 1994

Dr. Steven M. Cather
New Mexico Bureau of Mines and Mineral Resources
Campus Station
Socorro, New Mexico 87801

Dear Dr. Cather:

I am writing to inquire if you plan to determine the absolute age dates for the volcanic rocks in the Tertiary units in the recently drilled 1 Alpine-Federal hole in east-central Arizona. Please note that the Arizona Geological Survey is interested in the dates you may obtain on these rocks and, of course, in any publications including the results of your studies of the Tertiary rocks in the Alpine hole.

The 1 Alpine-Federal hole also penetrated dark-colored volcanic rocks in the Permian units at depths of about 3,640, 4,260, and 4,455 feet. Do you think these volcanic rocks are related time-wise to the volcanic rocks in the Tertiary units? If you feel that a determination of the absolute age dates for the volcanic rocks in the Permian units would be useful to your studies, and if you are interested in obtaining these dates, please let me know. I would be more than happy to collect and forward samples of these volcanic units to you.

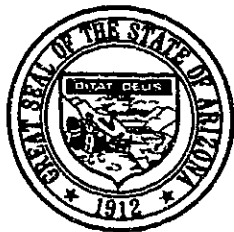
Also enclosed for your information is a copy of a preliminary report on a geochemical analysis of the 1 Alpine-Federal hole. Samples for this analysis were collected every 50 feet through the Tertiary units and every 20 to 10 feet through the Cretaceous and Permian units.

Sincerely,

Steven L. Rauzi

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosure



Fife Symington
Governor

State of Arizona
Arizona Geological Survey
845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

May 23, 1994

Mr. Frank Mancini
Arizona Department of Commerce
3800 North Central Ave., Suite 1200
Phoenix, Arizona 85012

Dear Frank:

A complete copy of Humble Geochemical Services' *Preliminary Report on Geochemical Analysis* for the 1 Alpine-Federal well is enclosed. As you can see from the cover letter accompanying this preliminary report, additional analyses on the well are forthcoming as is a final report, a copy of which will be forwarded to the Department of Commerce.

As I mentioned on the phone this morning, and in a recent meeting of the **Oil and Gas Conservation Commission**, Humble Geochemical Services provided these analyses at no cost to the State. I have, therefore, sent a copy of the two page discussion, of the organic facies plot, and the kerogen type and maturity plot to each of the individuals and companies that purchased a copy of our recent open-file report 94-1 on the implications of oil shows in the Alpine hole with instructions to contact Humble Geochemical Services directly with any questions or comments on the preliminary geochemical report.

By sending this report out, I not only confirm the conclusions on oil potential drawn in our recent open-file report with a geochemical analysis, I alert those who bought our recent open-file report that Humble Geochemical Services has done this work and that a final report is forthcoming. This increases Humble Geochemical Services' name recognition and it may help Humble Geochemical Services derive some economic benefit after providing this service at no cost to the State.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosure



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

May 16, 1994

Daniel M. Jarvie, President
Humble Geochemical Services
P. O. Box 789
Humble, Texas 77347

Dear Dr. Jarvie:

This will acknowledge receipt of your preliminary report on the Alpine hole. Thank you! I have sent a copy of the two-page discussion, organic facies plot, and the kerogen type and maturity plot to each of the Commissioners. If I am not misinterpreting the data, it seems that they may rest assured on the basis of your preliminary report that the 1 Alpine-Federal does indeed contain potential hydrocarbon source rocks. We truly look forward to your final report.

Several individuals including independent operators, consulting geologists, and retired medical doctors have called to get information on this hole. Merrion Oil and Gas Company, Farmington; Quest Petroleum Corp., Reno; and Paarup Oil Ltd, Calgary, have also called expressing interest in this hole.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator



Humble Geochemical Services

Division of Humble Instruments & Services, Inc.

P.O. Box 789 • Humble, Texas 77347

218 Higgins Street • Humble, Texas 77338

TELEPHONE: (713) 540-6050

FACSIMILE: (713) 540-2864

Geochemical Services for Exploration, Development and Production

May 11, 1994

Steven L. Rauzi
Arizona Geological Survey
845 N. Park Avenue #100
Tucson, AZ 85719

Ref: #1 Alpine-Federal

Dear Dr. Rauzi:

Enclosed is a preliminary report for the 143 samples from the #1 Alpine-Federal well sent to us for TOC and Rock-Eval analyses. We will be completing additional analyses (vitrinite reflectance and thermal extraction/gas chromatography) in the future. At the completion of this work, I will write a final report.

Please call if you have any questions or if we can be of further assistance.

Sincerely,

Daniel M. Jarvie
Daniel M. Jarvie

DMJ/cb

HUMBLE INSTRUMENTS & SERVICES, INC.

P.O. BOX 789
HUMBLE, TEXAS 77347
(713) 540-6050

Invoice

DATE	INVOICE #
11 May 94	2054

BILL TO:**SHIP TO:**

Arizona Geological Survey
Attn: Steven L. Rauzi
845 N. Park Avenue #100
Tucson, AZ 85719

PO. NUMBER	TERMS	REP	SHIP	VIA	F.O.B.	PROJECT
	no charge		11 May 94	Mail	P94B-64	

QUANTITY	ITEM CODE	DESCRIPTION	PRICE EACH	AMOUNT
143	S107	TOC ANALYSIS	10.00	1,430.00
24	S109	ROCK-EVAL ANALYSIS	25.00	600.00

1	Research	As per Daniel M. Jarvie to Steven Rauzi there is no charge for this project. Project completed for customer at no charge - This is to credit charges for Rock-Eval + TOC anal.	-2,030.00	-2,030.00
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No charge

TOTAL

0.00

BALANCE DUE:

0.00

5-10-94

Mr. Frank Mancini
ARIZ DEPT COMMERCE ENERGY OFFICE
3800 N CENTRAL STE 1200
Phoenix AZ 85012

Dear Frank:

Enclosed is a copy of the water-well acceptance form (A.A.C. R12-7-129) filled out with modification as an observation well by the U.S. Geological Survey Geothermal Studies Project.

The form has been filled out to the satisfaction of the Oil & Gas Commission and notarized as required by the above referenced rule.

Let me know if I can be of further help.

Sincerely,

Steve

Steven L. Raut
Oil & Gas Program Administrator

Enclosure

SENT BY: USGS Geothm. MenloPark 05-06-94 09:03AM

4153294876

6026385105 # 1



United States Department of the Interior

GEOLOGICAL SURVEY
Mail Stop 923
Geothermal Studies Project
345 Middlefield Road
Menlo Park, CA 94025-3591



☆☆☆ TELEFAX COVER SHEET ☆☆☆

DATE: 5-6-94

TO:

Steve Rauzi

FROM:

Tom Moses

415-329-4870

*Call + advise
Tom that this
will be
acceptable
to the Comm.
SLR*

2 PAGES (INCLUDING COVER SHEET)

5/6/94

COMMENTS/MESSAGE:

Steve:

Will the attached be ^{an} acceptable
substitute for the top part of your
Water Well Acceptance Form 26 - if so
will be glad to sign & return - I am
have it notarized here

Tom

FAX: (415) 329-4876



SENT BY:USGS Geothm. MenloPark 05-06-94 09:03AM

4153294876+

6036385105 # 2

To: Oil and Gas Conservation Commission
c/o Oil and Gas Program Administrator
Arizona Geological Survey
845 North Park Avenue, suite 100
Tucson, Arizona 85719

This is to advise you that the Geothermal Studies Project of the U.S. Geological Survey will accept the abandoned geothermal exploration well, known as the Alpine #1 Federal, located on the NW 1/4 of the SW 1/4 of Section 23, Township 6N, Range 30E, County of Apache, Arizona, as an observation well to be used for scientific purposes.

Further, the Geothermal Studies Project of the U.S. Geological Survey will accept full responsibility for the proper maintenance and use of the above well, including its final plugging, in full compliance with the Rules adopted by the Oil and Gas Conservation Commission.

I further understand that the Geothermal Studies Project of the U.S. Geological Survey is responsible for compliance with the provisions of the State Water Code, Chapter 1, Title 45, Arizona Revised Statutes and with any applicable requirements of the U.S. Geological Survey, Bureau of Land Management and U.S. Forest Service.

Signature _____
Address _____

*acceptable to the
Comm. SLR 5/6/94*



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

April 26, 1994

Mr. Daniel M. Jarvie, President
Humble Geochemical Services
P. O. Box 789
Humble, Texas 77347

Dear Dan:

Just a note expressing the Oil and Gas Conservation Commission's continued interest in your geochemical analysis of the 1 Alpine-Federal in eastern Arizona. Have you reached any conclusions about organic richness, petroleum potential, thermal maturity, and kerogen type? Any opinions on the relative contribution of volcanism to the thermal maturity? The contractor's final geothermal assessment and report should be ready in about a month. If this would be of any value to you, please let me know and I'll see about getting you a copy.

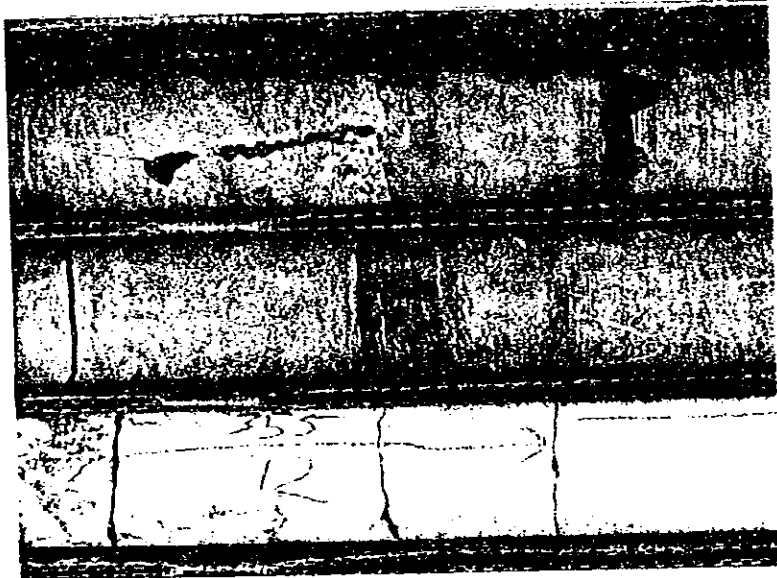
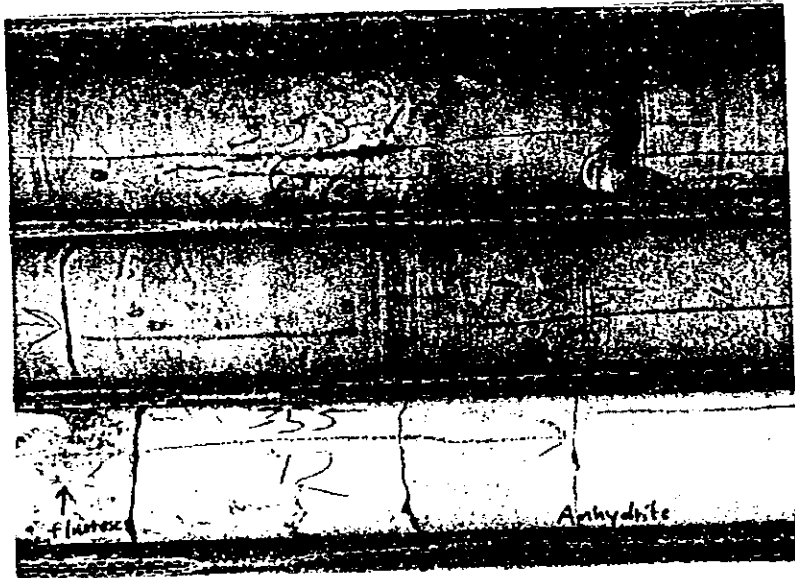
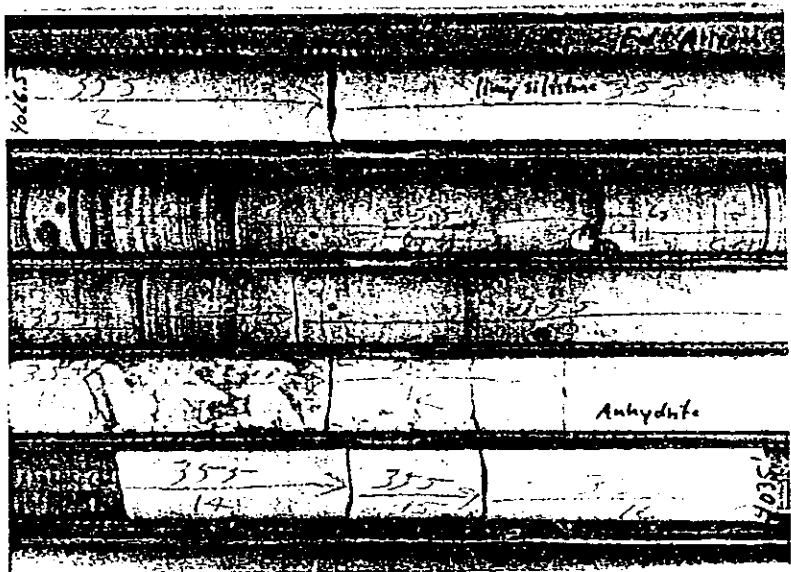
The photographs of the oil stains at about 4,028 feet and the vug at about 4,385 feet are enclosed for your information. The close-up photograph at about 4,028 feet is rotated about 1/3 three times.

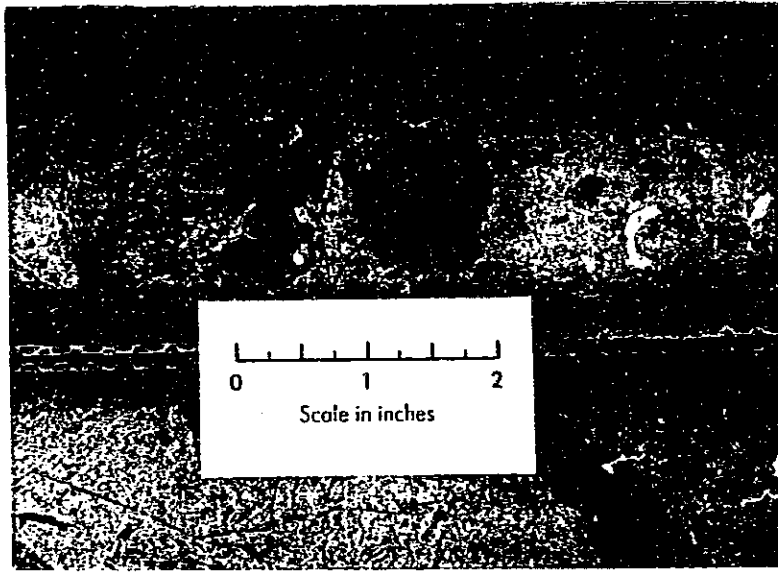
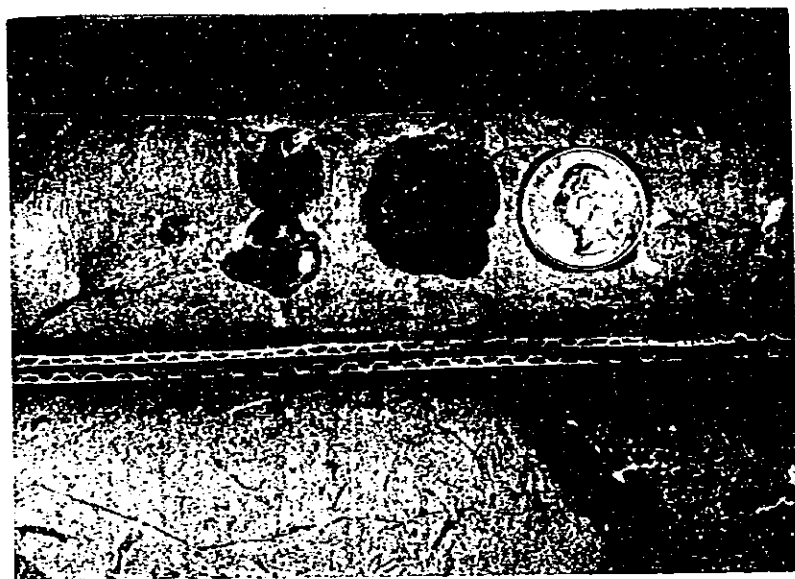
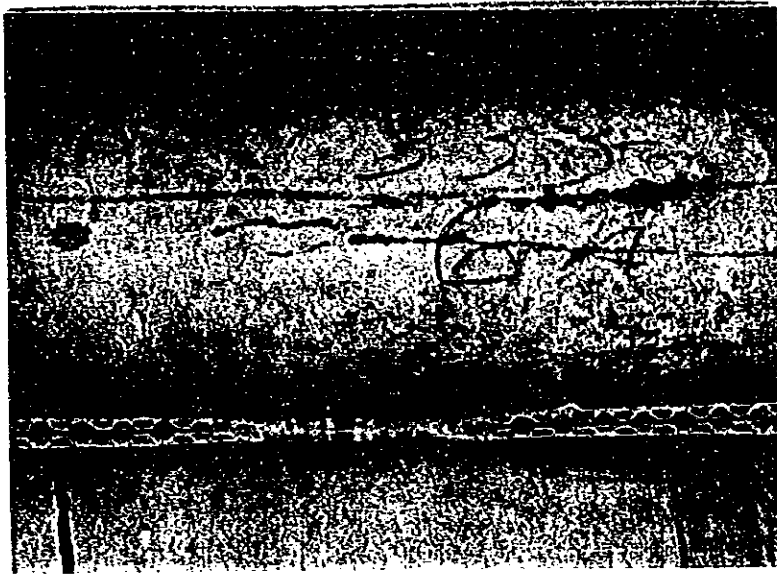
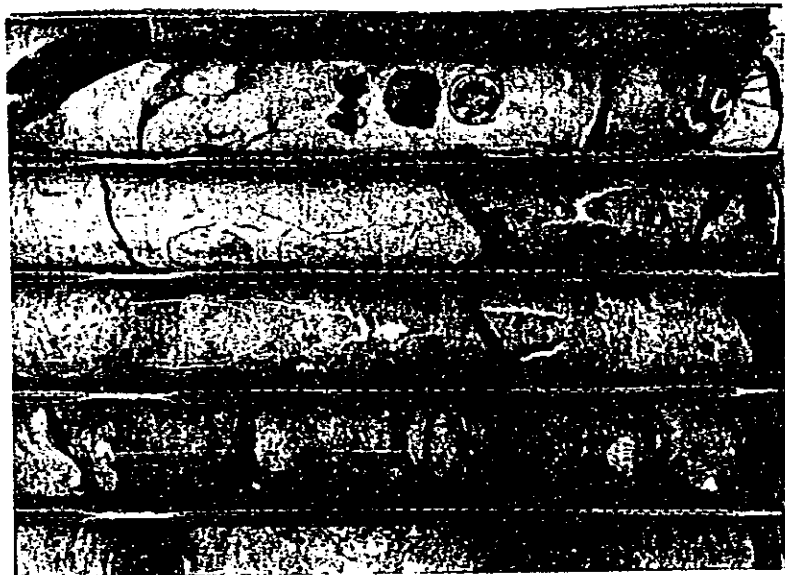
Again, the Commission appreciates your interest in this well and looks forward to the results of your analysis. Please let me know if I may be of any assistance.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosures: Selected photographs of 1 Alpine-Federal core.







United States Department of the Interior

GEOLOGICAL SURVEY

Office of Earthquakes, Volcanoes, and Engineering
Drilling Project
Mail Stop 923
345 Middlefield Road
Menlo Park, CA 94025



April 21, 1994

Dr. J. Haenichen
Director, Energy Office
Arizona Department of Commerce
3800 North Central, Suite 1200
Phoenix, AZ 85012

file 878
ARIZONA
CONSERVATION COMMISSION

APR 2 1994

Dear Dr. Haenichen:

The Geothermal Studies Project of the U.S. Geological Survey in conjunction with the U.S. Department of Energy would like to arrange for the orderly transfer of the ownership of the geothermal test well known as Alpine #1 Federal (AZ State Permit #878) located in the NW quarter of the SW quarter of section 23, Township 6 North, Range 30 East, Apache County, Arizona, from Tonto Drilling Services, Inc., Salt Lake City, Utah, to the U.S. Geological Survey in order to continue the scientific studies currently under way and to also use this opportunity to solicit additional funding for deepening the hole to basement.

A letter from Mr. John E. Mock, Director of the Department of Energy's Geothermal Division, is on file with the Arizona Oil and Gas Commission stating that funds will be available to the U.S. Geological Survey's Geothermal Studies Project for plugging and abandoning the well in accordance with the regulations set forth by the Arizona Oil and Gas Commission.

The U.S. Department of Agriculture, Forest Service, has issued a Memorandum of Understanding between the U.S. Geological Survey and the U.S. Forest Service which transfers the surface access and site cleanup requirement of Alpine #1 Federal from Tonto Drilling Services, Inc., to the U.S. Geological Survey. Additionally, the U.S. Geological Survey has a pending request with the Arizona Oil and Gas Conservation Commission asking for an orderly transfer of the drilling permit from Tonto Drilling Services, Inc., to the U.S. Geological Survey.

The U.S. Geological Survey appreciates your interest in preserving this hole for additional scientific endeavors during the next two

or three years and looks forward to continued cooperative efforts
on future wells of interest.

Sincerely,

Thomas H. Moses, Jr.

file 878

Thomas H. Moses, Jr.
Engineer

cc: J. H. Sass
Steve Rauzi
F. Mancini

RECEIVED
CONSERVATION COMMISSION

APR 27 1994



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

March 30, 1994

Mr. John Somers II, President
High Plains Petroleum Corporation
3860 Carlock Dr.
Boulder, CO 80303

Dear John:

A copy of the Spring 1994 *Arizona Geology* and extra prints of the vugs in the Fort Apache Limestone in the 1 Alpine-Federal are enclosed. The photographs include two close-up prints of the vugs with accompanying scale and two prints showing the general appearance of the Fort Apache Limestone (basal Corduroy Formation of Permian Supai Group) from 4,380 to 4,388 feet.

A good summary of the stratigraphy in the 1 Alpine-Federal is available in my open-file report 94-1 *Implications of Live Oil Shows in eastern Arizona Geothermal Test*. This is the last item listed on the enclosed list of available oil and gas related publications of the survey.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosures



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

March 18, 1994

Mr. Harris Crosby
1216 South Doran Street
Mesa, Arizona 85204

Dear Mr. Crosby:

A copy of my article on the 1 Alpine-Federal hole in the January 4, 1994, issue of *Oil and Gas Journal* is enclosed. This article and my recent open-file report, *Implications of live oil shows in eastern Arizona geothermal test*, are based on my own examination of the core from the 1 Alpine-Federal hole. I have also enclosed a list of oil and gas publications.

As you can see from the article, I did not concentrate on stratigraphy or structure but rather focused on the oil shows in Permian rocks and their implications to the hydrocarbon potential of eastern Arizona and western New Mexico. I did not consider geothermal because that will be the focus of Southwest Technology Development Institute's report to the Arizona Department of Commerce. The Arizona Geological Survey plans to make this report available after it has been approved by the Department of Commerce.

Let me know if I may be of additional assistance.

Sincerely,

Steven L. Rauzi
Oil and Gas Program Administrator

Enclosures



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

March 18, 1994

Mr. Ron Broadhead
Senior Petroleum Geologist
New Mexico Bureau of Mines and Mineral Resources
Socorro, New Mexico 87801

Dear Ron:

I am enclosing a gratis copy of my recently finished open-file report on the 1 Alpine-Federal hole in eastern Arizona and a copy of my article in the January 4, 1994, issue of *Oil and Gas Journal*. I also offer a belated thank you for providing completion data for some of the wells in Catron County.

Please feel free to comment on the open-file report. As you can see, I did not concentrate on stratigraphy or structure but rather focused on the oil shows in Permian carbonate units and their implications to the hydrocarbon potential of eastern Arizona and western New Mexico.

If you are ever in Tucson, please stop by and take a look at these shows. They are pretty, especially considering they exist below such extensive volcanism at the surface.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosures



United States Department of the Interior

GEOLOGICAL SURVEY

Office of Earthquakes, Volcanoes, and Engineering

Drilling Project

Mail Stop 923

345 Middlefield Road

Menlo Park, CA 94025-3591



March 16, 1994

Mr. Steven L. Rauzi
Oil and Gas Conservation Commission
Arizona Geological Survey
845 North Park Ave., Suite 100
Tucson, AZ 85719

AZ OIL & GAS
CONSERVATION COMMISSION
MAR 13 1994

Dear Mr. Rauzi:

After considering the request from the legal staff for the Arizona Oil and Gas Conservation Commission as outlined in your phone call of March 11, I don't think it will be possible to provide the assurances the staff feels are necessary. The problem lies in the nature of the Federal Government which I suspect is similar to that of the State of Arizona. In the Federal Government, only the legislative body can authorize the expenditure of funds and only for the current fiscal year. Thus an entity like the Department of Energy can spend and obligate funds budgeted during the fiscal year, but at the end of the year (September 30), any remaining funds have to be returned to the U.S. Treasury. Under special circumstances, funding can be carried over to the next fiscal year; however, this is not applicable in this instance, as we do not know in which fiscal years the studies, possible deepening, and eventual abandonment will be completed.

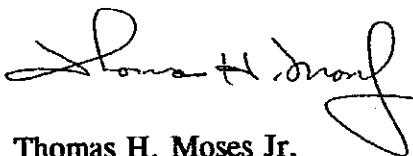
John E. Mock, the Director of the Geothermal Division of the Department of Energy's Office of Renewable Energy Conversion, Energy Efficiency and Renewable Energy, has the authority, as has any program administrator in the Federal Government, to obligate expenditures in accordance with the rules and regulations of his agency. Accordingly, he can approve funding for various programs, adjust budgets as necessary, and provide for contingency expenditures when required. The program that provided the bulk of the funds used to drill the Alpine #1 Federal hole was authorized by Congress, approved by DOE, and obligated by Dr. Mock. I doubt that Mock's superiors provided any assurances to the Arizona Department of Commerce manifesting Mock with the authority to provide the funds for the Alpine Project. Dr. Mock's offer was made in good faith, and previous commitments similar to this have always been honored in the past.

The U.S. Geological Survey has, as previously stated, "taken over" numerous wells throughout the United States and its territories including several wells drilled under the NURE program in

Arizona. Some wells are on private property while others are Federally owned. In all cases where the Geothermal Studies Project of the USGS has an agreement with either the Federal and/or applicable State agency, we have fulfilled that obligation to the letter and the spirit of the law. We value our reputation and have no intention of operating in any fashion that would change the respect gained through years of hard work and fulfilled promises to the oil and gas industry, the regulatory agencies, both State and Federal, and the scientific community. In this instance, we will do no less, and Dr. Mock's letter of January 31, 1994, indicating support for our continued studies and funding for completion of the Alpine #1 Federal is merely additional assurance of our intentions to operate by the rules. We also have a Memorandum of Understanding with the USFS in which we have agreed to "abide by the well completion stipulations as required by the Bureau of Land Management and the State of Arizona."

As far back as 1991, the Geothermal Studies Project has been involved in the Alpine-Springerville Geothermal Project, including an invitation on April 14, 1993, from the Director of the Energy Office of the Arizona Department of Commerce, Dr. J. Haenichen, "to participate in the scientific studies." Taking over the well with its associated obligations is a continuation of our effort to provide the scientific collaboration that the State requested. I suppose it's a sign of the times, or perhaps we have all become so distrusting, that it is not possible to accept written or verbal assurances, a sad state of affairs. Although this letter may not satisfy the Oil and Gas Conservation Commission's legal staff, hopefully we can move on to completion of the agreement allowing the Geothermal Studies Project to continue its studies with eventual deepening and/or plugging of the well. If we as a Federal agency are to continue to collaborate on this and future drilling projects with the State of Arizona, especially where we have been asked to participate, a certain degree of trust must evolve, as has been the case with other states and has been the prior case with the State of Arizona.

Sincerely,



Thomas H. Moses Jr.
Engineer

cc: John E. Mock
Dale Nations
Larry Fellows



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

March 14, 1994

Mr. John Bedell
Forest Supervisor
Apache National Forest
P. O. Box 640
Springerville, AZ 85938

Dear Mr. Bedell:

Please accept the enclosed gratis copy of Open-File Report 94-1, *Implications of Live Oil Shows in Eastern Arizona Geothermal Test*. This report is based on data from the recently drilled 1 Alpine-Federal, which indicates hydrocarbon potential beneath volcanic rocks in eastern Arizona.

Please feel free to contact me if you or any member of your staff have any questions about the report.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

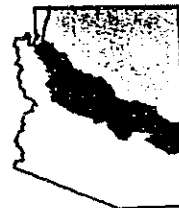
Enclosure



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

March 4, 1994

Mr. Daniel M. Jarvie
Humble Geochemical Services
P. O. Box 789
Humble, Texas 77347

Dear Dan:

I have finally completed sampling the core from the 1 Alpine-Federal geothermal test in eastern Arizona. I took a sample about every 50 feet or so through the Tertiary (surface to 3,260 feet) and about every 10 feet or so through the Cretaceous, San Andres Limestone, and parts of the Supai Group. Samples depths are recorded on the enclosed list. The samples themselves are being shipped separately.

The strongest shows of oil occur in and above the Fort Apache unit of the Supai Group as described in the enclosed draft of my open-file report. I referred to Humble Geochemical Services preparing a "geochemical log and report" on page 2 of the draft copy. Is my description of your report as a "geochemical log and report" accurate? Plates for the report are still in drafting.

We look forward to the results of your analysis. Please let me know if I may be of further assistance.

Sincerely,

Steve

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosure

2-25/3-3/4

TONTON #1 (PINE-FEDERAL NW (123 T. 6N, R. 30E. ARIZONA

	504	2002	3315	3845	4225
	553	2052	3330	3865	4230
	604	2104	3340	3878 *	4235 *
	652	2164	3350	3885	4245
	714	2204	Cret. 3360	3905	4255
	754	2254	San Andres 3370	3915	• 4260
	804	2304	3380	3925	Dike 4265
	854	2364	3390	3945	4295
	904	2404	3397	3965	4325 *
	954	2464	3400	3975 Shale *	Dike 4355
	1002	2504	3410	3975 Carb.	4365
Dirt	1064	2560	3420	3985	4375
Base	1114	2604	3430	4005	4385
	1164	2663	San Andres 3435	4015	4395
	1214	2704	Gilchrist ss 3465	4025	• 4397
	1274	2754	3495	• 4028 *	• 4402
	1314	2802	3525	4045	4405
	1384	2862	3555	4060	• 4413
	1434	2902	3585	4065	Supai (P. A. Bk) 4415
	1481	2966	Glor. 3615	4085	4425
	1534	3106	Dike 3645	• 4089	• 4428
	1584	3156	3690	4105	4435
	1634	3206	Supai (Comb. for) 3755	4115	4445
	1694	3255	3785	4125	Dike 4455
	1750	3265	3795	• 4130	4465
	1800	3275	3805	4145	4485
	1848	3285	3815	4165	4505 T.D.
	1902	3294 *	3825	4185	
	1953	3305	3835	4205	(143 samples)

FEB-17-94 THU 14:59 AZ STATE PROCUREMENT

P. 02



FIFE SYMINGTON
GOVERNOR

J. ELLIOTT HIBBS
DIRECTOR

ARIZONA DEPARTMENT OF ADMINISTRATION
STATE PROCUREMENT OFFICE
Executive Tower, Suite 101, 1700 West Washington, Phoenix, Arizona 85007
(602) 542-5511

file 878

CERTIFIED MAIL
RETURN RECEIPT REQUESTED (P 363 450 189)

AZ WIL & GAS
CONSERVATION COMMISSION

February 17, 1994

FEB 27 1994

Larry Pisto, Manager
TONTTO DRILLING SERVICES, INC.
P. O. Box 25128
2200 South 4000 West
Salt Lake City, Utah, 84120

RE: Contract No. A3-0041-001 (Alpine/Springerville Geothermal Project)

Dear Mr. Pisto:

The following represents the State of Arizona's position on certain contractual obligations under the above referenced contract number and the Department of Commerce, Energy Office (DCEO) concern about your firm fulfilling subject mandated requirements.

This office is by way of this formal notice, issuing an official cure date for initiation of immediate corrective action. Therefore, upon receipt of this letter, you are hereby notified that your organization has ten (10) calendar days to respond in writing to this office outlining your plan of action to ensure that the remainder of the contract period will be accomplished as contractually required. In addition, you must present a comprehensive explanation of why your organization has apparently failed to provide the drilling raw data under your existing geothermal program (i.e., preliminary assessment of findings during drilling operations). The contract, specifically Page 9, Paragraph 4 and associated sub-paragraphs outline the required tasks. Several additional key issues that should also be addressed are as follows:

- * Sub-contractor has been fostering the concept of taking the site authorization from the State of Arizona and

Larry Pisto, Manager
TONTTO DRILLING SERVICES, INC.
February 17, 1994
Page 2 of 3

transferring such authority to either the United States Geological Survey or other interested parties. The subcontractor must understand and agree that he is not authorized nor permitted to address any issues pertaining to the sites actual findings of the drilling nor to introduce other concepts that are contrary to the State of Arizona's direction pursuant to the contract. For the record, no information can be released without the prior written approval of the State.

- * The hole has not yet been plugged and abandoned in accordance with the drilling permit and pursuant to the terms of the contract.
- * Site location was discussed several times and was asked for in the Best and Final Offer and was incorporated into the contract award. It was agreed to by both parties that a site within the Springerville-Alpine geothermal anomaly would satisfy the State's requirements. The actual site chosen was the United States Forestry Service location at Alpine and technically known as Alpine #1/Federal Bore Hole (State Permit #878). This area is shown on the Geothermal Resources of Arizona Map dated 1982.
- * Page 11, Paragraph 6.2 of the contract states: "The contractor shall provide an acceptable Final Geothermal Report to the State Agency. The report shall contain all pertinent information, data, data evaluations, projections, conclusions, and recommendations gathered or prepared by the contractor during the course of the project." Will this report be forthcoming?
- * Page 11, Paragraph 6.3 states: The contractor shall furnish the State Agency with five (5) copies of the final approved report. In addition to the final report, the contractor must submit a final business report detailing all expenses incurred, payments made, and balances due. Will this requirement be completed and submitted with the overall final report?

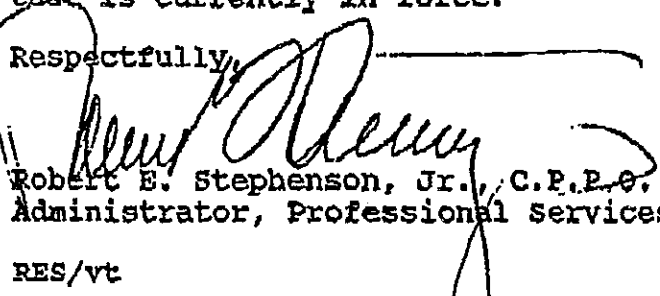
Larry Pisto, Manager
TONTA DRILLING SERVICES, INC.
February 17, 1994
Page 3 of 3

- * Invoices totalling approximately \$171,000.00 are being withheld until delivery of final report has been received and accepted and the hole has been plugged and abandoned.
- * No authority has been granted to any agency the right to cause your company to be released from your contractual obligations. This office has by way of this correspondence put the surety company on notice that no such authorization will be forthcoming to terminate or cancel the performance bond currently in effect. Your company is still legally responsible to retain such coverage until all mandates of the contract have been satisfied.

Should you fail to respond to this request, your organization could be held in breach of contract with the State of Arizona, and appropriate action will be initiated.

I urge you to consider the seriousness of our concerns and that all necessary steps on your part are taken to ensure, by return mail, that the utmost priority and attention are given to the contract that is currently in force.

Respectfully,


Robert E. Stephenson, Jr., C.P.P.O.
Administrator, Professional Services

RES/vt

cc: Margaret E. McConnell, Administrator, SPO
Frank Mancini, Az Dept of Commerce, Energy Office
Bob Dyson, United States Forest Services/Alpine Region
Nyles Lackey, P.E., Project Officer, U S Dept of Energy
Az Oil & Gas Commission
Steven Rauzi, Arizona Geological Survey
File (Contract A3-0041-001)



United States Department of the Interior

GEOLOGICAL SURVEY

Office of Earthquakes, Volcanoes, and Engineering
Drilling Project
Mail Stop 923
345 Middlefield Road
Menlo Park, CA 94025-3591



file 878
February 7, 1994

Mr. Steven L. Rauzi
Oil and Gas Conservation Commission
Arizona Geological Survey
845 North Park Ave., Suite 100
Tucson, AZ 85719

Dear Mr. Rauzi:

The Geothermal Studies Project of the U.S. Geological Survey in conjunction with the U. S. Department of Energy would like to arrange for the orderly transfer of ownership of the geothermal test well known as Alpine #1 Federal (AZ State Permit #878) located in the NW quarter of the SW quarter of Section 23, Township 6 North, Range 30 East, Apache County, Arizona, from Tonto Drilling Services, Inc., Salt Lake City, Utah, to the U.S. Geological Survey. We are requesting this transfer in order to continue the current scientific studies and to use this opportunity to solicit additional funding for deepening the hole to basement.

Enclosed is the original of a letter from Mr. John E. Mock, Director of the Department of Energy's Geothermal Division, to the Arizona Oil and Gas Commission stating that funds will be available to the U.S. Geological Survey's Geothermal Studies Project for plugging and abandoning the well in accordance with the regulations set forth by the Arizona Oil and Gas Commission.

The U.S. Department of Agriculture, Forest Service, has already issued a Memorandum of Understanding between the U.S. Geological Survey and the U.S. Forest Service which transfers the surface access and site cleanup requirement of Alpine #1 Federal from Tonto Drilling Services, Inc., to the U.S. Geological Survey. I believe you have already received a copy of the MOU.

The U.S. Geological Survey appreciates your interest in preserving this hole for additional scientific endeavors during the next two or three years and looks forward to continued cooperative efforts on future wells of interest.

Sincerely,

Thomas H. Moses Jr.
Thomas H. Moses Jr.
Engineer

Enclosure



Department of Energy
Washington, DC 20585

January 31, 1994

file 878

Mr. Steven L. Rauzi
Oil and Gas Administrator
Arizona Geological Survey
845 North Park Ave., Suite 100
Tucson, AZ 85719

Dear Mr. Rauzi:

As I mentioned to you in my letter of November 15, 1993, we have a continuing interest in the State of Arizona - U.S. Department of Energy Hot-Dry-Rock test well completed in August, 1993. Our accomplishments of obtaining continuous core, commercial geophysical logs, and high-resolution temperature logs represented a substantial body of scientific data. However, two important objectives of great scientific value, critical to the assessment of the hot-dry-rock geothermal potential of the Springerville area, were not achieved.

1) Penetration of Precambrian basement rocks. Any potential geothermal reservoir will be located in the crystalline basement, but the hole bottomed out short of the Precambrian target. One of the critical questions regarding the geothermal potential of this area turns on whether the high heat flow observed in the sedimentary section continues a significant distance into the crystalline basement rocks.

2) Open-hole investigations including logging, downhole measurements, and fluid sampling. The nature of the procurement precluded completion of these important tasks.

The successful conclusion of the original contract requirements has led us to the following suggestion. Rather than abandon the well at this point, there is an opportunity for additional coring and testing before abandonment. The USGS is proposing to take over as operator of the well and to assume all responsibility from the present contractor (Tonto Drilling Inc.), and DOE will provide funding of up to \$25,000 to ensure a satisfactory plugging and abandonment of the well at the conclusion of this process.

1-31-94 p. 2

The USGS will operate the hole as a thermal observation well until a satisfactory equilibrium temperature profile has been obtained. The researchers hope to deepen the well to reach Precambrian basement rocks, and additional funding will be sought by Mr. James Witcher of New Mexico State University (NMSU) and Dr. John Sass, Chief of the Heat-Mining Project, USGS. Upon completion of the scientific studies, the hole will be plugged and abandoned by the USGS or completed in a manner consistent with its employment as a long-term observation well for climatic-change studies and other purposes.

I greatly appreciate your cooperation and support in this project. Thank you again for your interest.

Sincerely,

John E. Mock
John E. Mock, Director
Geothermal Division
Office of Renewable Energy Conversion
Energy Efficiency and Renewable Energy



Humble Geochemical Services

Division of Humble Instruments & Services, Inc.

P.O. Box 789 • Humble, Texas 77347
218 Higgins Street • Humble, Texas 77338

TELEPHONE: (713) 540-6050

FACSIMILE: (713) 540-2864

Geochemical Services for Exploration, Development and Production

February 2, 1994

Steven L. Rauzi
Arizona Geological Survey
845 North Park Avenue #100
Tucson, Arizona 85719

file 878

Dear Mr. Rauzi:

Thank you for your response to my inquiry regarding geochemical analysis of the 1 Alpine-Federal geothermal well. I have enclosed sample bags for your utilization in taking pieces of the core for analyses.


The type of analyses which we would like to perform include total organic carbon (TOC) and Rock-Eval pyrolysis. If oil staining or high indigenous levels of hydrocarbons are detected, we would also like to run thermal extraction-pyrolysis/gas chromatography. The total amount of sample required for these analyses is approximately 200-400 milligrams which would be a chip of core the size of a pencil eraser. If possible we would like 2-3 chips of that size but that is not required. We would like to provide a profile using 30 foot intervals. Any coaly intervals and any intervals showing oil staining or other interesting organic characteristics should be sampled. These are destructive tests requiring approval of the Arizona Oil and Gas Conservation Commission per article 6.c of the sample policy.

These analyses would detail the organic richness, petroleum potential, thermal maturity, and kerogen type (oil/gas proneness) of all samples analyzed. The goal is to determine which interval(s) are the best sources of petroleum (if any) with the above delineation. The data would be returned within 30 days as specified in the sample policy.

We look forward to analyzing this well and trust it will prove helpful to the Arizona Geological Survey.

Thank you for your consideration.

Sincerely,


Daniel M. Jarvie
President



United States
Department of
Agriculture

Forest
Service

Alpine
Ranger
District

P.O. Box 469
Alpine, AZ 85920
602 339-4384
TTY 602 339-4566

Reply To: 2720

Date: January 24, 1994

file 878

Mr. G.A. McLaren
Tonto Drilling Services
2200 South 4000 West
Salt Lake City, Utah 84120-0128

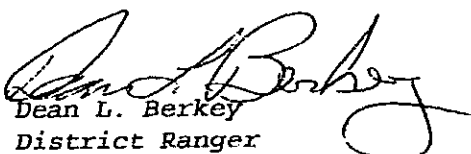
Dear Mr. McLaren:

The Forest Service has entered into an agreement with the Geological Survey (USGS) whereby the geothermal well at Alpine, Arizona is now being managed by the USGS. Effective immediately, the Special Use Permit issued to Tonto Drilling on 6/11/93 to conduct geophysical exploration at the Alpine well location is terminated.

The USGS is responsible for the well site and any reclamation work, thus Tonto Drilling Services is relieved of any further responsibilities at this site. By copy of this letter, the Forest Service releases the surety bond issued by the Insurance Company of the State of Pennsylvania.

I appreciate your spirit of cooperation throughout this project and wish you every success.

Sincerely,


Dean L. Berkey
District Ranger

RAD/bjs

cc: Jim Witcher, NMSU
Steven Rauzi, AZ Geological Survey
John Hass, BLM
John Sass, USGS
Tim Moses, USGS
Insurance Co. of Pennsylvania



Caring for the Land and Serving People

FS-6200-28b(3/92)

Copy to Disk, 2/1/94

file 87V

MEMORANDUM OF UNDERSTANDING
between the
APACHE NATIONAL FOREST
U.S. FOREST SERVICE
DEPARTMENT OF AGRICULTURE
and the
GEOTHERMAL STUDIES PROJECT
U.S. GEOLOGICAL SURVEY
DEPARTMENT OF INTERIOR

WHEREAS, The U.S. Geological Survey, herein referred to as USGS, desires to use as an observation hole an existing drill hole in Apache National Forest, and

WHEREAS, The U.S. Forest Service, herein referred to as USFS, is authorized under the Act of 1897 and Sections 251.1 and 251.2 of Title 36, Code of Federal Regulations, to make available to the USGS the use of National Forest lands for this purpose.

NOW, THEREFORE, The Apache National Forest herein referred to as the Forest Service, acting by and through the Forest Supervisor, Springerville, Arizona, and the USGS agree as follows:

A. THE USFS WILL:

1. Grant Permission, subject to existing laws, regulations, and all valid existing claims, to the USGS for the use of lands in the Alpine Ranger District, Apache National Forest for the purpose of monitoring and maintaining an existing drill hole located as shown on Exhibit A.

B. THE USGS WILL:

1. Prior to use and occupancy of National Forest lands, establish liaison with the Alpine District Ranger of the Apache National Forest, Alpine, Arizona, and take up directly with the District Ranger all matters relating to such use of National Forest lands.
2. Agree to maintain improvements and premises to standards of repair, orderliness, neatness, sanitation, and safety acceptable to the Forest Supervisor and, in exercising the privileges authorized by this Agreement, comply with the regulations of the Department of Agriculture and laws which are applicable to the area of operations covered by this Agreement; and fully repair all damage, other than ordinary wear and tear, to National Forest roads and trails, resulting from the exercise of the privileges authorized by this Agreement.

- file 878*
3. Do everything reasonable within its power and require its employees, contractors, and employees of contractors to do everything reasonably within their power, both independently and upon request of the Forest Service, to prevent and suppress fires on or near the land to be occupied under this memorandum of understanding.
 4. Agree, upon completion of the study, to clean-up, restore, and re-vegetate the site to the satisfaction of the Forest Supervisor.
 5. Notify the Alpine District Ranger, in writing, at least 10 days prior to any planned changes in the proposed operation.
 6. Abide by the well completion stipulations as required by the Bureau of Land Management and the State of Arizona.

C. THE USFS AND THE USGS MUTUALLY AGREE:

1. That this Interagency Agreement may be terminated or amended at any time by mutual consent of the USFS and the USGS. Following such termination, negotiations will be undertaken for a substitute agreement, if such is needed.
2. That upon final termination of this or any substitute Interagency Agreement, the USGS will remove any improvements that have been erected, unless otherwise agreed upon in writing, and will leave the site in a condition acceptable to the USFS. If determination is made to leave any said improvements in place, the USGS, to the extent it may lawfully do, will transfer said improvements to the USFS.

DEPARTMENT OF AGRICULTURE, U.S. FOREST SERVICE
Apache National Forest

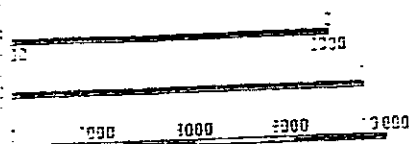
Date 1/18/94 by John P. Bodell
Title Forest Supervisor

DEPARTMENT OF INTERIOR, U.S. GEOLOGICAL SURVEY
Geothermal Studies Project

Date 9-8-93 by James H. Brown
Title Engn



INTERIOR GEOLOGICAL SURVEY, RESTON, VIRGINIA-1991



ARIZONA

QUADRANGLE LOCATION

1	2	3	1 Eagle
			2 Nelson Reservoir
			3 Loco Knoll
4		5	4 Rock Knoll
			5 Escudilla Mountain
			6 Buffalo Crossing
6	7	8	7 Alpine
			8 Luna Lake

ADJOINING 7.5' QUADRANGLE NAMES

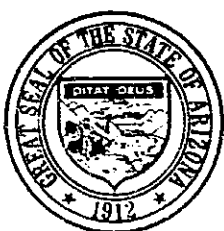
ROAD LEGEND

Improved Road
 Unimproved Road
 Trail
☐ Interstate Route ☐ U.S. Route ☐ State

NUTRIOSO, ARIZONA
 PROVISIONAL EDITION

53109-H2-TF-024

RACY STANDARDS
 2. COLORADO 80225



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

January 21, 1994

Mr. Daniel M. Jarvie
Humble Geochemical Services
P. O. Box 789
Humble, Texas 77347

Dear Daniel:

Thank you for your letter of January 6, 1994, and your offer to analyze samples from the 1 Alpine-Federal geothermal well in Arizona. The Arizona Oil and Gas Conservation Commission will certainly consider giving you samples from the core for analyses as long as you are willing to abide by the conditions of the Commission's sample policy, which I have enclosed.

What type of analyses do you propose? The core from the Alpine hole is about 2.5 inches in diameter and the Commission would like to preserve the integrity of as much of the core as possible. How much sample will you require for the type of tests that you propose?

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosure

Don called 1-24: a 200 mg sample (size of pencil eraser). TOC, Rock-eval, maturity, Kerogen type (Pyrolysis). Make geochemical log with sample rate of 30 feet or so. Also pick up anything unusual that doesn't fall in the 30 ft interval. Thermal extract in spurs with oil shows.

STATE OF ARIZONA
OIL & GAS CONSERVATION COMMISSION
SAMPLE POLICY

The Oil and Gas Conservation Commission hereby adopts the following as its policy regarding samples and cores. In the declaration policy "samples" is meant to include rotary and cable tool cuttings, chips, cores, core slabs, and core chips.

1. Samples received by the Commission under A.A.C. R12-7-121 shall be preserved and maintained in good order.
2. A record or file shall be kept indicating the location of samples from each well.
3. Samples are to be maintained for use as a public library.
4. Samples may be examined on the premises by any person requesting to do so. Reasonable notice for retrieval of the samples may be required.
5. Samples may be loaned for use off-premises to any responsible person at the discretion of the Commission.
6. Users of samples shall take reasonable and customary measures to maintain the integrity and volume of each individual sample and shall not mix samples together.
 - a. Users may use ordinary tests for mineralogical determination. Acid shall not be placed in the bulk sample, rather, one or two individual grains may be removed to a separate container for acid tests.
 - b. Solvents shall not be placed in the bulk sample, rather, one or two individual grains may be removed to a separate container for solvent tests.
 - c. In no case shall bulk solvent extraction, pyrolysis, or other destructive tests be run on any samples without prior permission of the Commission.
7. Users shall return all individual samples to their original containers. If the container is damaged beyond use, a new container shall be provided.
8. Users shall replace all samples in order from top of the hole down in the original sample box.
9. Users shall provide the Commission, within 30 days of their completion, copies of all logs, paleontological and other reports, maturation studies, source rock analysis, and any other study or analysis made possible by use of samples from the Commission's library. The Commission shall grant a six-month confidentiality period if so requested by the owner of the report and may grant one six-month extension of the period of confidentiality if so requested.

ADOPTED AS REVISED BY THE OIL AND GAS CONSERVATION COMMISSION ON 11/21/86



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

January 5, 1994

Mr. Wallace Bayne
Merrion Oil & Gas Corporation
P. O. Box 840
Farmington, New Mexico 87499

Dear Wallace:

I am sending the well location map of the Colorado Plateau province that we talked about this morning. This map is somewhat dated, but contains some water well information that is not available in our *Well Location Map and Report*, which is current through September 1993. The Colorado Plateau map is being updated with oil, gas, and stratigraphic wells drilled since January 1, 1975, but not water wells.

I have also enclosed a copy of the Oil and Gas Conservation Commission's sample policy since you mentioned possible geochemical studies on the core from the 1 Alpine-Federal geothermal hole. As for migrated vs. insitu oil, I can't imagine oil migrating very far in the tight carbonate rocks in the Alpine hole even though units underlying the penetrated Permian rocks must overlap the south edge of the "Defiance Positive Area" and extend southward into the deeper Pedregosa basin. I am curious as to how petroliferous the Fort Apache and underlying units were before Mesozoic erosion vs. after and how important was the volcanism of the area in maturing these rocks?

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosures

STATE OF ARIZONA

OIL & GAS CONSERVATION COMMISSION

SAMPLE POLICY

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ADOPTED AS REVISED BY THE OIL AND GAS CONSERVATION COMMISSION ON 11/21/86



Humble Instruments & Services, Inc.

P.O. Box 789 • Humble, Texas 77347
218 Higgins Street • Humble, Texas 77338

TELEPHONE: (713) 540-6050

FACSIMILE: (713) 540-2864

Geochemical Instrumentation, Hardware, Software & Services

January 6, 1994

Steven L. Rauzi
Arizona Geological Survey
845 North Park
Suite #100
Tucson, AZ 85719

Dear Mr. Rauzi:

I recently read your article in the *Oil & Gas Journal* regarding the possibility of oil potential in Eastern Arizona. Based on the visual and lithologic descriptions in your article, it may be interesting to determine geochemically the source potential of the Cretaceous rocks. In addition it would be interesting to evaluate the oil shows cited in both the Cretaceous and Permian.

We operate a organic geochemical laboratory and I have enclosed information on our services for your perusal.

We offer these analyses at no charge on samples from this well. If you have additional samples, special pricing for the Arizona Survey would be considered. Our interest would be to eventually evolve a non-proprietary regional geochemical study in this area.

If you have an interest in pursuing this, please contact me.

Thank you for your consideration.

Sincerely,


Daniel M. Jarvie

DMJ/cb



Humble Geochemical Services

Division of Humble Instruments & Services, Inc.

P.O. Box 789 • Humble, Texas 77347

218 Higgins Street • Humble, Texas 77338

TELEPHONE: (713) 540-6050

FACSIMILE: (713) 540-2864

Geochemical Services for Exploration, Development and Production

November 1993

1993 Price Schedule for Analytical Services

(All prices quoted per sample)

I. Sample preparation services

1. Sample cleaning (if necessary), grinding and homogenization for 60 mesh grain size (< 2 grams) \$ 3.50
2. Sample cleaning, grinding and homogenization for 20 mesh grain size (> 2 grams) \$ 10.00
3. Basic Lithologic Description \$ 3.50
4. Bulk Extraction (no recovery of extract) \$ 10.00
5. Kerogen Isolation * \$ 30.00

II. Headspace & Cuttings Analysis

1. Chromatographic analysis of headspace gas (C1-C5 & C6+) from cuttings and side-wall cores (Schlumberger Jars) \$ 30.00
2. Chromatographic analysis of gas contained in cuttings (C1-C6+) from a drilling well after they are ground in sealed containers \$ 30.00

III. Rock-Eval plus TOC Analysis

1. For samples with TOC < 0.50% TOC \$ 10.00
(includes both TOC and Rock-Eval data)
2. For samples with TOC > 0.50% TOC \$ 35.00
(includes both TOC and Rock-Eval data)
3. Rock-Eval Analysis only \$ 25.00
4. Leco Carbon Analysis * \$ 12.00
5. Carbonate Carbon \$ 10.00
6. Total Carbon \$ 9.00

IV. Microscopy: Ro, TAI, Kerogen Analysis

1. Vitrinite Reflectance, Kerogen Analysis, and Thermal Alteration Index (TAI) [includes all sample preparation] \$ 120.00
2. Vitrinite Reflectance Analysis Only [includes sample preparation] \$ 100.00
3. Visual Kerogen and Thermal Alteration Index (TAI) [includes sample preparation] \$ 75.00
4. Whole Rock Vitrinite Reflectance Only [includes sample preparation] \$ 75.00
5. Vitrinite Reflectance Analysis of client plugs/slides [no additional preparation] \$ 60.00

V. Sulfur Analysis

1. Leco Sulfur Analysis of Rocks, Oils * \$ 32.00
2. Elemental sulfur analysis \$ 32.00

VI. Solvent Extraction, Separation, Quantitation

- | | |
|---|----------|
| 1. Supercritical Fluid Extraction (SFE) with modifier..... | \$ 60.00 |
| 2. Solvent Extraction (SOXHLET or SoxTec) | \$ 60.00 |
| 3. Cold Soak Extraction | \$ 60.00 |
| 4. Packed Column Chromatography Separation/Quantitation | \$ 75.00 |

VII. Gas Chromatography and Pyrolysis/Gas Chromatography

- | | |
|--|-----------|
| 1. Gas Chromatographic traces of whole oil, extracts or fractions or thermal extract (S1) plus pyrolyzate (S2) (cyrogenic) (fingerprint only)..... | \$ 150.00 |
| 2. same as above but with peak tables..... | \$ 200.00 |

VIII. Reservoir Oil Fingerprint (ROF)

- | | |
|--|---------------|
| 1. Gas Chromatography of oil samples with detailed interpretation, statistical analysis, and graphic display using Chevron's PFR/Oilmix/Sliding Window (c) Software..... | \$ 220.00/oil |
| 2. Quantitative evaluation of oil mixing (comingled production).....
(requires 2 end member oils and unknown oil) | \$ 1,100.00 |
| 3. Additional interpretive services or training..... | \$ 600.00/day |

IX. Detailed Analysis

- | | |
|---|-----------|
| 1. Microscale Sealed Vessel Analysis | |
| A. Sealed Tube Products Gas Chromatography | \$ 150.00 |
| B. Sealed Tube Residue Pyrolysis Gas Chromatography | \$ 150.00 |
| C. Same as above but with peak tables | \$ 200.00 |
| 2. Elemental Analysis: | |
| A. CHNO or CHNS (requires kerogen) | \$ 75.00 |
| B. CHNOS (requires kerogen) | \$ 100.00 |
| 3. Carbon Isotope Analysis (saturate, aromatic or whole oil) * | \$ 40.00 |
| 4. Biological Marker Analysis: | |
| A. Saturate fraction * | \$ 400.00 |
| B. Aromatic fraction * | \$ 325.00 |
| 5. Hydrous Pyrolysis * | \$ 350.00 |
| 6. Kinetic Analysis: Rock-Eval derived using Discrete Model | \$ 650.00 |

X. 1D Basin Modeling Services

A. BasinMod 1-D Model (per well)

- | | |
|---|-------------|
| ** 1. Single iteration with graphics..... | \$ 1,200.00 |
| ** 2. Additional iterations with corresponding graphics | \$ 200.00 |
| 3. BasinMod model with graphics with all data researched for a given well | \$ 2,000.00 |

B. MATOIL or GENEX 1-D Model (per well)

- | | |
|---|------------|
| ** 1. Single iteration Genex model with complete graphics | \$1,500.00 |
| ** 2. Additional iterations of the same model with limited graphics | \$ 275.00 |
| 3. Matoil model with graphics with all data researched for a given well | \$2,300.00 |

* Subcontracted services

** Requires completion of modeling worksheet

XI. Detailed Interpretation 25% of total analytical charges

BASINMOD is a Trademark of Platte River Associates, Inc.
GENEX and MATOIL are registered trademarks of IFP

Prices subject to change without prior notification

EXPLORATION

Geothermal test hints at oil potential in eastern Arizona volcanic field

Steven L. Rauzi Arizona Geological Survey Tucson

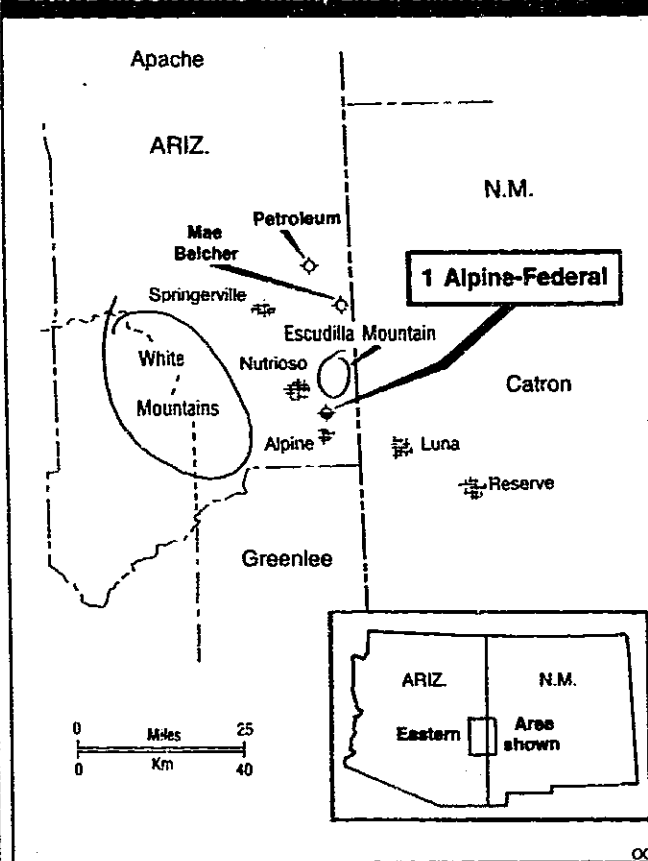
A recently drilled geothermal well, funded by the U.S. Department of Energy and the Arizona Department of Commerce, has provided information about the geology of east-central Arizona and west-central New Mexico.

Tonto Drilling Services in cooperation with New Mexico State University completed the well, the 1 Alpine-Federal, at a total depth of 4,505 ft on Aug. 29, 1993. The well is located among volcanic rocks in the Apache-Sitgreaves National Forest about 6 miles north of the town of Alpine and 6.2 miles west of the Arizona-New Mexico line in 23-6n-30e, Apache County (Fig. 1). Ground elevation at the wellsite is 8,556 ft.

The well was drilled to determine the hot dry rock geothermal potential of Precambrian rocks. The operator expected to penetrate Precambrian at about 4,200 ft, but the hole was still in Permian rocks at that depth and was in a mafic dike that intruded the Permian rocks at the total depth of 4,505 ft.

Thus the well did not provide any information about the depth and nature of the Precambrian rocks or the presence, thickness, and hy-

WHITE MOUNTAINS AREA, EAST-CENTRAL ARIZONA



drocarbon potential of Pennsylvanian, Mississippian, or Devonian rocks.

The hole did, however, show that Cretaceous and

Permian strata contain potentially important source rocks for oil and gas that are apparently unaffected by nearby volcanism. These po-

tential oil source rocks are the focus of this article.

Stratigraphy

The 1 Alpine-Federal, cored from 500 ft to total depth, penetrated Tertiary, Cretaceous, and Permian rocks (Fig. 2). The Permian rocks were cut by three mafic dikes.

The operator reported the Tertiary Datil formation at the surface, Eocene Baca formation at 1,093 ft, early Tertiary redbeds at 3,139 ft, Cretaceous rocks at 3,260 ft, Permian San Andres limestone at 3,369 ft, Permian Glorieta sandstone at 3,436 ft, and Permian Yezo (Supai) formation at 3,751 ft.

H. Wesley Peirce, in an initial inspection of the core with the author, identified the Fort Apache member of the Yezo formation from 4,224-4,414 ft. The Fort Apache member is cut by a mafic dike from 4,260-4,360 ft. The dike apparently did not alter these sediments to any appreciable extent, the widest baked zone being less than 3 in.

Tertiary strata

The Tertiary strata in the 1 Alpine-Federal consist of tuffaceous clastic rocks ranging from dense mudstone

and well in and sands conglomerate reported pebbles and casts and vases play finer grain top of the was picked rene of re conglomerate

Cretaceous

The Cretaceous which rests on sandstone, to light gray quartzose dense dark mudstone, between 3 and dark gray sandstone.

The limit angle of a some instances. The sand and pebbles. The gets progressively and more coarse. The operator reported Cretaceous including organic source rock what looked like the top of the

Woodward identified the stone as correlative redbeds in western Mexico.

Permian

The San Andres in the 1 Alpine-Federal is medium dark limestone. The dark, laminated bedded with to black shale. Stylolites black, earthy, al are common stone. The can be seen fingers.

The basal Andres incision zone of solution breccia. The of light color limestone the golden-color surrounded by dark gray critical mudstone

EXPLORATION

and well indurated siltstone and sandstone to boulder conglomerate. The operator reported paleosols with root casts and thin-bedded crevasse-splay deposits in the finer grained material. The top of the Baca formation was picked at the first occurrence of red granite clasts in conglomerate.

Cretaceous rocks

The Cretaceous rocks, which resemble the Dakota sandstone, consist of white to light gray coarse-grained quartzose sandstone and dense dark gray to black mudstone. Thin coaly seams between 3 and 4 in. thick and dark gray to black laminations are common in the sandstone.

The laminations dip at an angle of about 30° and in some instances are disrupted. The sandstone has a salt and pepper texture in places. The dark mudstone gets progressively lighter and more calcareous uphole. The operator described the Cretaceous sequence as being organic rich and an oil source rock and reported what looked like dead oil at the top of the Cretaceous.

Woodward and Grant¹ identified the Dakota sandstone as containing both potential reservoir and source beds in west-central New Mexico.

Permian oil shows

The San Andres limestone in the 1 Alpine-Federal is a medium dark gray micritic limestone. The limestone is dark, laminated, and interbedded with thin, dark gray to black shales.

Stylolites filled with a black, earthy organic material are common in the limestone. The organic material can be scraped off with the fingers.

The base of the San Andres includes a 2 ft thick zone of solution or collapse breccia. The breccia consists of light colored clasts of limestone that have an even, golden-colored fluorescence surrounded by non-fluorescing, dark gray to black micritic mudstone. The opera-

ROCK UNITS PENETRATED IN 1 ALPINE-FEDERAL

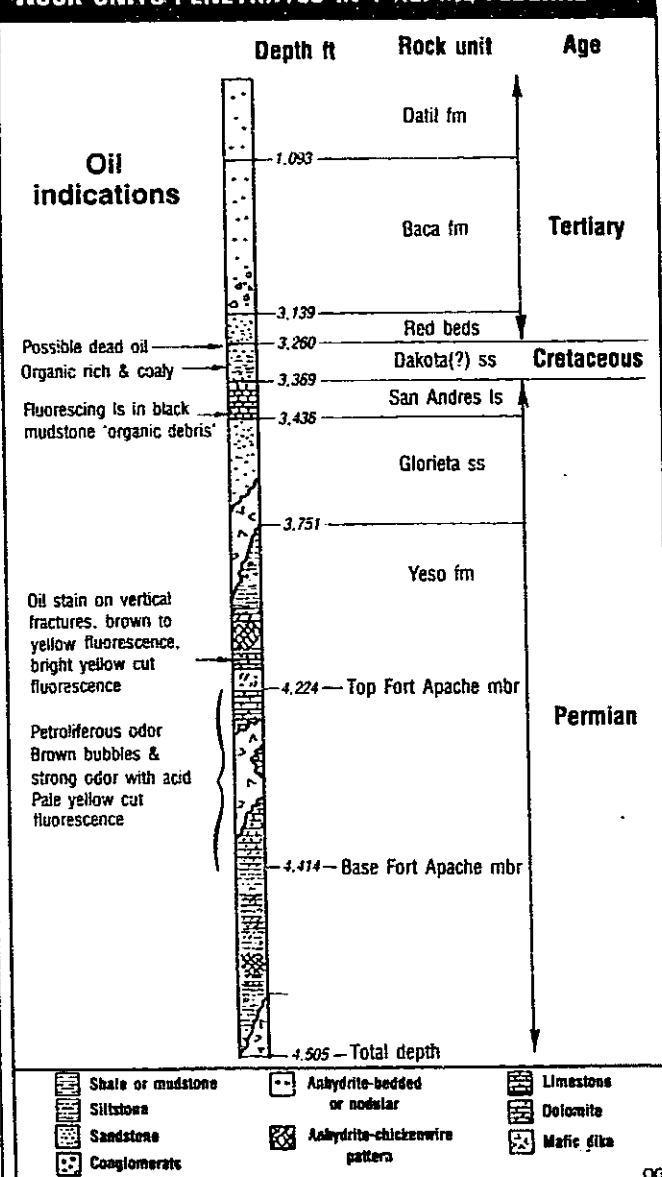


Fig. 2

throughout. Stylolites and small anhydrite nodules are common near the center of the zone. The zone yielded brown bubbles and a strong petroliferous odor when acid was applied.

Samples have a very faint straw-yellow cut and a pale-yellow cut fluorescence in 1,1,1-trichloroethane. A 2 ft interval at 4,028 ft contains fossil hash and has distinct oil staining along vertical fractures. These stains have a brown to yellowish-brown fluorescence and a bright yellow cut fluorescence.

The Fort Apache member is a rhythmically banded medium to dark gray fossiliferous limestone with thin dark laminations and numerous zones of yellowish-brown limestone. Porosity is pinpoint to very vuggy and vertical, calcite-filled fractures are present.

Dead oil stains some of the fractures and most of the pinpoint porosity. Most of the Fort Apache member has a faint petroliferous odor and yielded brown bubbles and a strong petroliferous odor when acid was applied. When the acid dried, distinct brown rims were evident on the rock.

The presence of petroliferous rock in the upper part of the Yeso was not unexpected. Heavy oil, oil staining, and dead to asphaltic oil were reported in the upper part of the Supai (Yeso) formation in several wells both north and west of the 1 Alpine-Federal.²

The petroliferous zone above the Fort Apache may correlate with a petroliferous zone reported above the Fort Apache in the Eastern Petroleum 1A Coyote Creek well, about 23 miles north of the 1 Alpine-Federal.

The 1 Alpine-Federal penetrated only 604 ft of the Permian Yeso formation. Isopach mapping based on the few wells to the west, north, and east suggests that as much as 1,500 ft of these rocks are present at this location, which leaves as much as 1,000 ft of Yeso beds yet

tor reported organic debris in the collapse zone. The strongest shows of oil in the 1 Alpine-Federal are in the Yeso formation, which consists of classic sea-margin sabkha deposits. Solution-brecciated blue-gray to light brown dolomite is interbedded with white to brown anhydrite and red to dark brown siltstone and mudstone. The anhydrite has a chickenwire pattern in places.

Scour marks and rip-up clasts of dolomite and anhydrite are present at the tops and bottoms of the siltstone and mudstone layers. Bioturbation, soft-sediment deformation, and nodular anhydrite surrounded with mudstone are common. Calcareous zones may represent disrupted algal mats.

This zone is a yellowish gray to yellowish brown with pinpoint porosity and thin dark laminations

EXPLORATION

to be penetrated at this locality. The presence of dikes may increase the depth necessary to fully penetrate the Yeso formation.

Pre-Permian rocks

The 1 Alpine-Federal well was not drilled deeply enough to encounter Pennsylvanian rocks.

Mapping by Wrucke,³ however, suggests that Pennsylvanian rocks may be present beneath the Yeso formation at the 1 Alpine-Federal location. Wrucke reported two large blocks of probable Pennsylvanian Naco limestone at elevations of 8,600 ft and 8,700 ft on the northeast flank of Escudilla Mountain, about 6.5 miles northeast of the 1 Alpine-Federal well. He surmised that volcanism had carried these large blocks of Naco limestone to the surface from their more extensive presence at depth.

The Pennsylvanian rocks are absent in two wells drilled north of Escudilla Mountain. The Eastern Petroleum 1A Coyote Creek in SW NE 27-10N-30E, about 23 miles north of the 1 Alpine-Federal, penetrated Permian rocks over granite at an elevation of +4,628 ft. The Mae Belcher 1 State in SW NE 20-9N-31E, about 18 miles north of the 1 Alpine-Federal, penetrated Permian rocks over granite at an elevation of about +4,366 ft.⁴

Thus Wrucke's recognition of the Naco limestone on Escudilla Mountain suggests that an edgeline of Pennsylvanian rocks exists between the 1 Alpine-Federal and the Mae Belcher and Eastern Petroleum wells. These rocks may be as much as 750 ft thick at the 1 Alpine-Federal location.^{5,6,7}

Regional isopach mapping suggests that as much as 165 ft of Mississippian rocks⁸ and 150 ft of Devonian rocks⁹ could be present at the 1 Alpine-Federal location. The Precambrian at the 1 Alpine-Federal location may be as deep as 6,570 ft, or rather, at an elevation of

+1,985 ft, about 2,400 ft structurally lower than the Precambrian surface at the Mae Belcher well.

Oil, gas possibilities

Woodward and Grant¹ reported that Devonian rocks in west-central New Mexico contained ideal source beds and noted the presence of potential source and reservoir rocks in the Pennsylvanian formations.

Stratigraphic traps may be present in these units where the Pennsylvanian, Mississippian, and Devonian rocks overlap the southward sloping Precambrian basement in the vicinity of the 1 Alpine-Federal. The oil and gas for these stratigraphic traps could have formed in place or migrated from Paleozoic source rocks in the deep Pedregosa basin to the south. Hydrocarbons may also have migrated from organic rich sediments deposited in ancient seas to the west and east of the 1 Alpine-Federal.

Stratigraphic traps in the Permian rocks may involve mafic dikes or sills. Igneous rock does not seem compatible with the accumulation of oil and gas, but in Northeast Arizona at Dineh-bi-Keyah field igneous rock of Tertiary age has produced more than 17 million bbl of a high gravity crude oil.

The igneous reservoir rock at Dineh-bi-Keyah field intruded white to light tan carbonates and black shales of the Pennsylvanian Hermosa formation and has yielded the largest amount of oil of any reservoir rock in Arizona.

The oil identified in the Permian rocks in the 1 Alpine-Federal could very well have accumulated in stratigraphic traps consisting of Permian-aged lenticular sands and fractured carbonates, or even in post-Permian igneous reservoir rocks.

Conclusions

The 1 Alpine-Federal penetrated three potentially important oil source rocks in east-central Arizona and west-central New Mexico

and showed that the Precambrian surface slopes more steeply to the south than was anticipated at this location.

Regional studies suggest that oil and gas may be trapped in pre-Permian formations yet to be penetrated at this locality.

The oil source rocks in the 1 Alpine-Federal include Cretaceous rocks, the Permian San Andres limestone, and most notably the Yeso formation. The Cretaceous contains organic material and possibly dead oil at the contact with the overlying Tertiary rocks.

The San Andres limestone was eroded to a thickness of 67 ft but contained an apparent collapse zone filled with angular to subrounded clasts of limestone cemented in dark gray to black mudstone with organic debris.

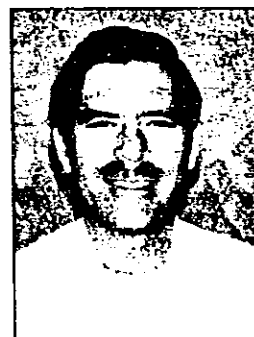
The best oil source rocks encountered in the hole were the petroliferous limestones of the Fort Apache member of the Yeso formation and limestone units above the Fort Apache member.

This region offers opportunities for exploration companies bold enough to explore for oil and gas beneath the extensive cover of volcanic rock in east-central Arizona and west-central New Mexico. Given that the oil source rocks in the 1 Alpine-Federal are unaffected by this volcanism, this region deserves further evaluation for oil and gas.

References

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2. Peirce, H. Wesley, Keith, Stanton B., and Wilt, Jan Carol., Coal, oil, natural gas, helium, and uranium in Arizona, Arizona Bureau of Mines Bull. 1823, 1970, 289 p.
3. Wrucke, Chester T., Paleozoic and Cenozoic rocks in the Alpine-Nutriso area, Apache County, Ariz., U.S. Geological Survey Bull. 1121-H, 1961, 26 p.
4. Foster, Roy W., Stratigraphy and petroleum possibilities of Catron County, N.M., New Mexico Bureau of Mines & Mineral Resources Bull. 85, 1964, 55 p.
5. Kottowski, Frank E., Pennsylvanian rocks on the northeast edge of the Datil plateau, in Weir, J.E., and Baltz, E.H., eds., Guidebook of west-central New Mexico, New Mexico Geological Society, 10th Field Conference, 1959, pp. 57-62.
6. Kottowski, Frank E., and Havenor, Kay C., Pennsylvanian rocks of the Mogollon rim area, Arizona, in Weber, R.H., and Peirce, H.W., eds., Guidebook of the Mogollon rim region, New Mexico Geological Society 13th Field Conference, 1962, pp. 77-83.
7. Kottowski, Frank E., Sedimentary basins of south-central and southwestern New Mexico, AAPG Bull., Vol. 49, No. 11 (November), 1965, pp. 2,120-39.
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THE AUTHOR



Rauzi

Steven L. Rauzi joined the Arizona Oil & Gas Conservation Commission in Phoenix in 1988. That agency was merged into the Arizona Geological Survey in 1991. He now serves as the oil & gas program administrator for the survey in Tucson. He worked for Texaco in Los Angeles as an exploration and development geologist during 1980-87. He received BS and MS degrees in geology from Utah State University in Logan.

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Source: Society of Petroleum Engineers	



United States Department of the Interior

GEOLOGICAL SURVEY
Geothermal Studies Project
2255 North Gemini Drive
Flagstaff, Arizona 86001

PHONE 001 602 556 7226
FAX 001 602 556 7169
jsass@flag2.wr.usgs.gov

FAX MESSAGE FROM JOHN SASS

*Sass called 12/1/93 to report
Moses and Johnson plan to
attend 12/4/93 mtg and request
copy of report on P&A and
status of the well.*

TO: Larry Fellows

DATE: November 19, 1993

As per our just concluded phone call, I am unable to attend today's meeting because of a family medical emergency. Following are some graphs and a table showing preliminary thermal data. These should not be considered as in the public domain yet as we have a great deal more lab and interpretative work, particularly on thermal conductivity, to get a consistent heat-flow result.

My position on taking over the well is summarized in Ted Mock's letter. We need to get Tonto released from their bond and get Ted's commitment of P&A funds accepted in lieu of a bond which, of course, federal government agencies are precluded by law from providing. In that connection, I should point out that the USGS and my project in particular has drilled over 50 research wells in Arizona, and has taken over several commercially drilled holes, including 5 of the NURE Uranium Exploration wells. In all cases we have plugged and abandoned the wells upon completion of our studies.

I'll be at my desk for most of the rest of the morning and reachable at the above phone and fax numbers.

Once again, sorry I can't attend the meeting.

3 PAGES FOLLOW: PLEASE DELIVER IMMEDIATELY

11 15/93

16:48

CE-12 RENEWABLE ENERGY COMU - 6026285126

NO. 346

DOE



Department of Energy
Washington, DC 20585

November 15, 1993

Mr. Larry D. Fellows
State Geologist
Arizona Geological Survey
845 North Park Ave., Suite 100
Tucson, AZ 85719

Dear Mr. Fellows:

As you know, the State of Arizona - U.S. Department of Energy Hot-Dry-Rock test well was completed near the end of August to the target depth of 4500 feet. A complete suite of continuous core was obtained between 500 feet and total depth, a limited set of commercial geophysical logs (gamma-ray/neutron) was run, and four high-resolution temperature logs were obtained by the U.S. Geological Survey (USGS) between August 31 and October 21. While this represents a substantial body of scientific data, two important objectives of great scientific value, critical to the assessment of the hot-dry-rock geothermal potential of the Springerville area, were not achieved.

1) Penetration of Precambrian basement rocks. Any potential geothermal reservoir will be located in the crystalline basement. Reasonable inferences from nearby outcrops and the nearest oil-exploration test wells indicated that basement would be encountered between 3300 and 4300 ft. A surprisingly thick sequence of Tertiary rocks and an unexpected layer of Mesozoic sedimentary rocks provided welcome new geologic data, but the hole bottomed out short of the Precambrian target. One of the critical questions regarding the geothermal potential of this area turns on whether the high heat flow observed in the sedimentary section continues a significant distance into the crystalline basement rocks.

2) Open-hole investigations including logging, downhole measurements, and fluid sampling. The nature of the procurement precluded completion of these important tasks.

With the successful conclusion of the original contract requirements, we have reached a decision point. Rather than abandon the well at this point, there is an opportunity for additional coring and testing before abandonment. The USGS is proposing to take over as operator of the well and to assume all responsibility from the present contractor (Tonto Drilling Inc.), and DOE will provide funding of up to \$25,000 to ensure a satisfactory plugging and abandonment of the well at the conclusion of this process. The USGS will operate the hole as a thermal observation well until a satisfactory equilibrium temperature profile has been obtained (temperature measurements to date are sufficient to satisfy Tonto's contractual obligations).

open-
ended

Dr. Allen J. ...

11 15/93

16:46

CE-12 RENEWABLE ENERGY CONU - 6026285106

NO. 346

603



Department of Energy
Washington, DC 20585

November 15, 1993

Mr. Larry D. Fellows
State Geologist
Arizona Geological Survey
845 North Park Ave., Suite 100
Tucson, AZ 85719

Dear Mr. Fellows:

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open-
ended

Dr. Allen J. ...

The researchers hope to deepen the well to reach Precambrian basement rocks. During the period of time needed to reach equilibrium temperature, additional funding will be sought by Mr. James Witcher of New Mexico State University (NMSU) and Dr. John Sass, Chief of the Heat-Mining Project, USGS. Contingent on acquiring the needed funds, a string of size-NQ drill rods left in the well will be partially removed to facilitate downhole testing. The size-NQ drill rods will then be rerun and the hole will be deepened with size-BQ into the crystalline basement. Open-hole measurements will then be made together with another series of temperature logs. Upon completion of this phase of measurements, the hole will be plugged and abandoned by the USGS or completed in a manner consistent with its employment as a long-term observation well for climatic-change studies and other purposes.

I greatly appreciate your cooperation and support in this project. The significant accomplishments we achieved are due to the group effort, and I would appreciate your help in continuing the scientific value of this well by transferring responsibility to the U.S. Geological Survey. Thank you again for your interest and collaboration on this important project.

Yours sincerely,

John E. Mock

John E. Mock, Director
Geothermal Division
Energy Efficiency and
Renewable Energy



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

October 25, 1993

Mr. Harris Crosby
1216 South Doran Street
Mesa, Arizona 85204

Dear Mr. Crosby:

I have enclosed a copy of the temperature, gamma, and neutron plots for the Alpine-Federal #1 geothermal test well.

Let me know if I may be of additional assistance.

Sincerely,

Steven L. Rauzi
Oil and Gas Program Administrator

Enclosures



Information: 505/835-5420
Publications: 505/835-5410
FAX: 505/835-6333

New Mexico Bureau of Mines & Mineral Resources
Socorro, NM 87801

A DIVISION OF
NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY

V.S. Ruzi
→ CDF

October 19, 1993

Larry D. Fellows
Director and State Geologist
Arizona Geological Survey
845 N. Park Avenue, Suite 100
Tucson, AZ 85719

Dear Larry:

We received the core from the geothermal test hole on 8/26/93. The core is now curated and on the shelves in our new core building. It consists of 300 boxes from the interval 502 - 3255.5 feet. A copy of the inventory is enclosed.

Thank you for your help in acquiring this core. As you know, we have a major mapping project in the adjacent Quemado 1:100,000 sheet and the core will be quite helpful. Also, Steve Cather of our staff has been studying the Eocene Baca formation and overlying volcaniclastic rocks of late Eocene-early Oligocene age and the core will provide an important stratigraphic control point for him.

Sincerely,

Charles Chapin
Director and State Geologist

/al

Enclosures CONSERVATION COMMISSION
OCT 22 1993



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

October 1, 1993

Mr. Harris Crosby
1216 South Doran Street
Mesa, Arizona 85204

Dear Mr. Crosby:

I have enclosed the completion report for the Alpine-Federal #1 geothermal test well. I understand that New Mexico State University will take temperature readings on this hole for another month or so and will submit them and a gamma log in November. That material will be available to the public.

Let me know if I may be of additional assistance.

Sincerely,

Steven L. Rauzi
Oil and Gas Program Administrator

Enclosure

SOUTHWEST TECHNOLOGY DEVELOPMENT INSTITUTE

Box 30001/Dept. 3SOL/Las Cruces, New Mexico 88003-0001
Telephone: (505) 646-1846
Telefax: (505) 646-2960



8/16/93

Steven L. Rauzi
Oil and Gas Program Administrator
Arizona Geological Survey
845 North Park Ave.
Tucson, Arizona 85719

AZ OIL & GAS
CONSERVATION COMMISSION

AUG 19 1993

878

Dear Steve:

An unusually thick section of Tertiary sediments, unconformable with underlying Cretaceous sandstones, probably indicates that a primary drilling objective, Precambrian crystalline basement, will not be achieved by the Tonto/Alpine #1/Federal bore hole (State permit #878) under the current contract unless a thin sequence of Paleozoic strata overlies the Precambrian. A "rigid" contract between Tonto Drilling Services of Salt Lake City and the Arizona Procurement Office in Phoenix precludes drilling past 4,500 feet depth, jeopardizing a satisfactory hot dry rock (HDR) evaluation of the White Mountains region in Arizona.

Great uncertainty exists as to the type of Precambrian rocks beneath the White Mountains area. It is of paramount importance to an HDR evaluation to determine the character of the Precambrian basement. A contingency solution to the problem of reaching Precambrian basement may include: (1) designation of the Alpine #1/Federal test as an observation hole for up to 2 years until the hole can be reoccupied and completed into basement and much desired scientific studies are complete. (2) transferring the responsibility and liability of the bore hole from Tonto Drilling Services to the U. S. Geological Survey (USGS) when the conditions of the Tonto/State of Arizona contract are fulfilled in January 1994. Under this scenario the USGS would plug and abandon the hole and restore the site under the terms and conditions of the Arizona Oil and Gas Commission, U. S. Forest Service, and U. S. Bureau of Land Management.

This contingency may provide the best alternative within the current drilling contract framework, provide a quality HDR assessment, and protect the bore hole from third party interference until an adequate evaluation is complete. Because a thorough HDR evaluation will insure the maximum geologic and geophysical information, a temporary observation hole status could lead to economic benefits to include the discovery of new oil and gas in Arizona. In any case, much scientific value will accrue to regional geologists who study Paleozoic stratigraphy and Precambrian terranes.

As geotechnical subcontractor to Tonto Drilling Services, I am working with Thomas H. Moses of the USGS in Menlo Park and John Sass of the USGS in Flagstaff to find a suitable contingency to complete the Alpine #1/Federal bore hole in Precambrian basement. Tom Moses may be reached at (415) 329-4870. Any assistance or feedback on how to proceed with regard to well designation and transfer of operators would be of tremendous importance to the Alpine #1/Federal HDR evaluation.

Sincerely,

A handwritten signature in dark ink, appearing to read 'J. C. Witcher'.

James C. Witcher
Geologist

cc
Larry Pisto
Frank Mancini
Tom Moses
John Sass

AUG-02-1993 12:40 FROM ARIZONA STATE OFFICE

TO

86026285106

P.02

FILE COPY
BUTLER

TONTO
DRILLING SERVICES, INC.

P.O. Box 25128
2200 South 4000 West
Salt Lake City, Utah 84120-0128
Telephone: (801) 974-0645 Fax: (801) 973-2994

July 20, 1993

Mr. John Haas
Bureau of Land Management
Phoenix, Arizona 85611-6563

Dear Mr. Haas,

During our conversation last week, we discussed 2 items: the choke manifold and the closing unit for the double gate BOPE.

I have taken this opportunity to inform you of our correction of these two items, as follows:

1. Choke Manifold

H and H Oil Tool has re-built the choke manifold, so that it conforms to the drawing you faxed to me on July 13th.

2. BOPE Closing Unit

H & H Oil Tool will replace the hand pump closing unit on Monday, July 19th with a small accumulator. In addition, we have hooked the drilling rig hydraulic system to the BOPE so that the drills can activate the BOPE from the control panel of the rig.

I appreciate your review of our locations, and look forward to a successful project that will be rewarding to all.

If you have any questions, please call me at (800)453-8290.

Incidentally John, I told our supervisor that you were highly complimentary of his work. He very much appreciated your comments.

Sincerely,

TONTO DRILLING SERVICES, INC.

Larry Pisto
Larry Pisto



Fife Symington
Governor

State of Arizona
Arizona Geological Survey
845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

FAX TRANSMITTAL COVER SHEET

DATE: 5-19-93

2 PAGES
(including cover sheet)

TO:

NAME:

John Haas

COMPANY:

Bureau of Land Management

FAX NO:

650-0556

CITY:

Phoenix

FROM:

Steve Rauzi

OUR FAX NO: (602) 628-5106

IF THERE ARE ANY QUESTIONS, RESPONSES, OR PROBLEMS WITH THIS
TRANSMISSION, PLEASE CALL THE SENDER AT (602) 882-4795.
THANK YOU.

MESSAGE:

BOP Stack for Alpine
Divide Core hole

JH calls 5-19-93

Consider conditions: (1) monitor temp of
drill mud hourly at every 30' (2) maintain min.
500 gal (or 2000' gal) core with air loss [i.e. item
15 on Oregon COA] - (3) test stack, pneumatic
chuck, and safety valve to 1000 psi. He did not
have diagram of BOP so faxed to him as
noted on cover sheet. SCR

LARRY KAY WHITMER

Registered Land Surveyor

Box 464

Alpine, Az. 85920

(602) 339-4535

To: Steven Rauzi

MAY 24 1993

Re: Location Survey of Tonto Alpine
#1 Federal at Alpine Divide

From: Larry Whitmer R.L.S.



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

May 18, 1993

Mr. Larry Pisto
Tonto Drilling Services, Inc.
P. O. Box 25128
2200 South 4000 West
Salt Lake City, Utah 84120-0128

Re: #1 Alpine-Federal, Sec. 23, T. 6 N., R. 30 E., Apache Co., Arizona
State Permit #878

Dear Mr. Pisto:

Enclosed are (1) approved performance bond, (2) approved Application for Permit to Drill, (3) Permit to Drill #878, (4) filing fee receipt #3040, and (5) instructions for handling well cuttings from the surface to the top of your coring point.

This office witnesses certain wellsite operations. Therefore, this Permit to Drill is issued on the condition that you *notify this office at least 48 hours* before you

- 1) Commence drilling operations;
- 2) Run and cement surface casing; and
- 3) Nipple up and test the BOPE prior to drilling out of the surface casing.

Enclosed are (1) Form 4, *Well Completion Report*, required within 30 days of completing the well; (2) Form 9, *Application to Plug and Abandon*, requires approval before commencing work to plug and abandon the well; (3) Form 10, *Plugging Record*, to record final placement of plugs; and (4) Form 25, *Sundry Notice*, to provide this office of weekly updates of wellsite activity. BLM forms may be substituted for Form 25.

I look forward to a successful completion of this well.

Sincerely,

Steven L. Rauzi

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosures



Fife Symington
Governor

State of Arizona
Arizona Geological Survey
845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

INSTRUCTIONS FOR HANDLING CUTTINGS FROM
SURFACE TO THE TOP OF THE CORING POINT

*
Two sets of cuttings, at a maximum interval of ten feet, shall be furnished to the Commission. All cuttings from the rotary drilled part of the hole, i.e. from the surface to the top of the coring point, shall be handled as follows:

1. All samples shall be properly washed and dried.
2. An amount, the equivalent of two tablespoons, of each sample shall be placed in envelopes or other suitable wrapping and clearly identified as to the depth at which it was taken. Envelopes shall be packaged in boxes of sufficient size and shape to accommodate the envelopes.
3. Samples shall be properly packaged for transporting in a manner that will protect the individual samples; each individual pack of samples shall contain the identification of the well from which the samples originated, the complete location of the well, and the Commission's permit number.
4. Ship or mail the cuttings, charges prepaid, to:

Oil and Gas Program Administrator
Arizona Geological Survey
845 North Park Avenue, Room 100
Tucson, AZ 85719
5. Whole cores shall be collected and handled as previously discussed and agreed to with the Arizona Department of Commerce. Deliver the core as specified in paragraph 4.

*
Contacted Dale Nations, Chairman of OGCC, on 9-23-93 and arranged the collection of only 1 set of sample in the amount of ~3 tablespoons. Relayed this information to Jim Wilcher 9-23-93.

SOUTHWEST TECHNOLOGY DEVELOPMENT INSTITUTE

Box 30001/Dept. 3SOL/Las Cruces, New Mexico 88003-0001
Telephone: (505) 646-1846
Telefax: (505) 646-2960



16 May 1993

Steven L. Rauzi
Administrator
Oil and Gas Program
Arizona Geological Survey
845 North Park, Suite 100
Tucson, Arizona 85719

MAY 17 1993

Dear Steve:

The enclosed addendum materials describe the revised abandonment procedures for the Tonto Alpine #1 Federal Application for Permit to Drill Geothermal Resources Well. If you have questions or comments please contact myself or Larry Pisto at Tonto Drilling (801) 974-0645.

Sincerely

A handwritten signature in dark ink, appearing to read 'J. Witcher'.

James C. Witcher
Geologist

5-14-93

John Haas, BLM, called to discuss the #1 Alpine-Federal well and relay the experience the Oregon office of the BLM has with this type of geothermal gradient hole. Their experience with sure-gel (plug mud) was not entirely positive. They recoiled against the use of sure-gel as a final plugging medium. One concern is getting a cement plug across the shoe of the 4.5 inch casing. SLP

5-14-93

I called Larry Pisto, Tonto Drilling, and reviewed my discussion with John Haas. They run the 1.5" steel liner inside of drill pipe then pull with the DP. as they prefer plug mud to cement to avoid cementing the drill pipe in the hole. They could run a back-off sub below the 4.5" csg shoe at 500' and place the cement plug across the 4.5" shoe. I advised him to call John Haas and discuss the casing and final abandonment in light of Oregon's experience.

5-14-93

Larry Pisto called to report his discussion with John Haas. They concluded that (1) no reason to cement bottom of the hole, (2) use left-handed thread a joint below 4.5" csg shoe, (3) leave regular drill mud in hole, and (4) pull the 1.5" steel casing and set cement plug across the 4.5" csg shoe at ~500' upon final abandonment. A cement plug will also be set at the surface in accordance with requirements. I concur with this plan. They will submit a revised drilling prognosis incorporating these changes. SLP



Fife Syrnington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

May 13, 1993

Mr. Ed Kaufman
7030 Isleta Blvd. SW
Albuquerque, New Mexico 87105

Dear Ed:

I received your letter of May 7, 1993. I wrote to Jim Lovekin on October 9, 1992, requesting that he provide this office with the temperature data on the Phillip's geothermal holes near Alpine. He did not favor this office with a response.

I am not aware of any hole drilled at the Alpine golf course that encountered water too hot to water the greens. It may be that the well you refer to was drilled long ago and is now plugged. I called the current operator of the golf course and they were not aware of such a hole. Their wells are relatively shallow and do not produce water too hot to water the greens.

Also, I have enclosed a copy of Tonto's application to drill the #1 Alpine-Federal. The permit for this well has not yet been issued.

Let me know if I can be of further assistance.

Sincerely,

Steven L. Rauzi
Oil & Gas Program Administrator

Enclosures



Fife Symington
Governor

State of Arizona
Arizona Geological Survey

845 North Park Avenue, #100
Tucson, Arizona 85719
(602) 882-4795



Larry D. Fellows
Director and State Geologist

May 12, 1993

Mr. Harris Crosby
1216 South Doran Street
Mesa, Arizona 85204

Dear Mr. Crosby:

Enclosed is the information you requested, a copy of Tonto Drilling Services, Inc.'s Application for Permit to Drill the #1 Alpine-- Federal well.

The permit for this well has not yet been issued.

Sincerely,

Steven L. Rauzi
Oil and Gas Program Administrator

Enclosure

TONTO.
DRILLING SERVICES, INC.

P.O. Box 25128
2200 South 4000 West
Salt Lake City, Utah 84120-0128
Telephone: (801) 974-0645 Fax: (801) 973-2994

May 11, 1993

Mr. Steve Rauzi
Oil and Gas Administrator
Arizona Geological Survey
845 North Park, Suite 100
Tucson, Arizona 85719



Dear Mr. Rauzi,

I have enclosed a cross-sectional diagram of the BOP equipment we will use on this project. Please include this in our permit file, which you opened for us recently.

I would like to state that absolutely no flow testing will be done on this project. Consequently, we have applied to the forest service for permits, rather than the BLM.

We still have not received the survey plats from our surveyor; I will get them to you as soon as possible after we receive them.

If you have any questions about this, please call me at (800)453-8290.

Sincerely

TONTO DRILLING SERVICES, INC.


Larry Pisto

LP/lss

cc: Jim Witcher

Enclosures

SOUTHWEST TECHNOLOGY DEVELOPMENT INSTITUTE

Box 30001/Dept. 3SOL/Las Cruces, New Mexico 88003-0001
Telephone: (505) 646-1846
Telefax: (505) 646-2960



29 April 1993

MAY 3 1993

Steven L. Rauzi
Oil and Gas Program Administrator
Arizona Geological Survey
845 N. Park, Suite 100
Tucson, Arizona 85719


Dear Steve:

Please find the enclosed Plan of Exploration Operations for the Alpine core hole. I am also sending a copy of the Core Logging Procedures of the Southwest Technology Development Institute/NMSU. The core logging procedures include diagrams on how the core barrel and retrieval mechanisms work because many of our projects in New Mexico include geology and geological engineering students at NMSU as well site logging assistants.

Review the Plan of Exploration Operations. If you have comments or questions, I would be happy to address them.

I am finalizing our well site scientific program and operations and geologic logging plan and procedures. I will send you a copy if you are interested.

Sincerely,


James C. Witcher
Geologist

TONTO
DRILLING SERVICES, INC.

P.O. Box 25128
2200 South 4000 West
Salt Lake City, Utah 84120-0128
Telephone: (801) 974-0645 Fax: (801) 973-2994

April 29, 1993

APR 30 1993

Mr. Steven L. Ranzi
Oil and Gas Program Administrator
Arizona Geological Survey
845 North Park, Suite 100
Tuscon, Arizona 85719

Dear Mr. Ranzi,

I have enclosed two copies of each of the following documents:

- Corporate Organization Report
- Application for Permit to Drill Geothermal Resources Well
- Performance Bond - amount of \$5,000.00
- \$25.00 filing fee

The surveyor is scheduled to have the survey plat to me on Tuesday, May 4, 1993, and it will be immediately forwarded to you.

If you have any questions, please call me at (800)453-8290, or Jim Witcher, Southwest Technological Development Institute at (505)646-1846.

Sincerely,

TONTO DRILLING SERVICES, INC.



Larry Pisto

LP/lss

MEMORANDUM

DATE: March 24, 1993
FROM: Steven L. Rauzi, Oil and Gas Program Administrator
SUBJECT: Water wells in vicinity of Section 23, T. 6 N., R. 30 E.

From AZGS OFR 80-1 (page 100-104): Heat-Flow Test-Hole 116 (SW NE SW 23-T6N-R30E)

The upper 400' of hole 116 was drilled using an air compressor and downhole hammer. It produced about 10 gpm of 16.7° C water at 230'. The general lithology is as follows:

Surf-521'	521' of pinkish-tan medium- to fine-grained sandstone
521'-823'	302' of orange-red coarse-grained sandstone
823'-1123'	400' of red-brown to black clay, siltstone, and black basaltic? lithic fragments

Reg Barnes (255-1543), Department of Water Resources records note two domestic water wells in this vicinity:

1. NW SW NE 22-T6N-R30E: 10" diameter, 210' deep, water level at 3', producing 15 gpm.
2. NE SE SW 26-T6N-R30E: 6" diameter, 155' deep, water level at 143', producing 12 gpm.

Their records include a Forest Service well drilled on 8/30/79 in NW NW SE 23-T6N-R30E that is 1235' deep. The driller's notes in this file indicate this well (1) encountered water in the Coconino sandstone at 1200' to 1235', (2) was not tested yet but may be tested in a year, (3) is perforated from 450' to 650', and (4) has a water level at 140'.